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PRESENTATION OF THE MEDAL OF THE AMERICAN INSTITUTE OF CHEMISTS[1]

THE MEDALIST

LAFAYETTE B. MENDEL first saw the light of day in the village of Delhi, New York, on February 5, 1872. A boyhood composition prepared at school and entitled "Our Village," which once fell into my hands, tells us that Delhi was a very beautiful village, and also we learn that it had a railway station. Mendel entered Yale at the age of fifteen as the youngest member of his class and graduated in due course. I remember distinctly the punctilious politeness with which he, as graduate student of twenty-one, took off his hat when in the streets of New Haven he passed me, a professor of the age of twenty-six. I mention this merely to indicate that we have been friends for thirty-five years. I would also remark that in the course of years this attitude has been reversed and that to-night I take off my hat to him.

Mendel, like many who have become broadminded and influential men, had an early and thorough grounding in the classics, and his knowledge of Latin has remained with him throughout his life. Such training gives an intellectual background which represents a continuity of education from its beginnings in the ancient world. It has always contributed to the power of those possessing it. A generation ago there was scarcely a member of the British Parliament who could not, like our friend of this evening, quote Horace to his purpose.

As has been said, Mendel's early life was spent at Delhi and to this home he has ever since returned for his summer vacations. The local physicians have been his friends and councilors. With them he has taken many a long drive in the old-fashioned buggy and made calls upon the sick and learned medicine as the country doctor knew it. The doctor of the old school, who would drive a horse twenty miles of an afternoon to see a sick man living far away, perhaps in a desolate habitation, was one from whom lessons, not only of medicine, but also of conduct, could be learned. Inspiration came even as the fresh air which entered the lungs during the long drive. Some one has pointed out that the modern doctor in his Ford can no longer ruminate upon the

[1] Rumford Hall, Chemists' Club, New York City, May 11, 1927.

case he may have attended in a house as he passes it, but rather upon a narrow escape from a collision which had happened to him there a few months before. Nor will the Ford bring the tired doctor home without giving a thought, as Dobbin would bring the buggy home.

There is no doubt that much of the harmony in the life of Lafayette Mendel is derived from the love of the serenity of his native village of Delhi, and of the scenes and friends of his boyhood.

It is known to all that Mendel is the most illustrious of Chittenden's pupils. He received his doctorate of philosophy from the hands of Chittenden in 1893. He studied with Heidenhain at Breslau and with Baumann at Freiburg in 1895 and 1896. From the time of his graduation he was closely associated with Chittenden in teaching and research at the Sheffield Scientific School, and when Chittenden became director of the Scientific School in 1898 the direction of the laboratory became increasingly Mendel's personal responsibility.

In these early days of the beginnings of scientific medicine in the United States there was one dominant group of alert and able scientific men associated together, that at the Johns Hopkins University under the presidency of Gilman. This represented an atmosphere of scientific stimulation unequaled anywhere at that period. The Chittenden-Mendel School was a sporadic manifestation, an offshoot of the school of Samuel Johnson, the pioneer agricultural chemist. It originated and was maintained in a miserable building utterly devoid of the trappings found in our stately modern laboratories. The mechanical toys which are our present-day delight were not the meat on which this our Caesar fed. But life in squalor does not subdue the things of the spirit, and things of the spirit were in that old building. A merchant may see his shop and goods destroyed by fire and the next day arrange for carrying on the business, of which he alone is master and which he alone can inspire. And so, too, in science. Great buildings, much to be desired as they are, may become tawdry non-essentials unless the human spirit can soar above their comforts and luxuries.

The work of a man's life is equal to the sum of all the influences which he has brought to bear upon the world in which he lives. It does not depend on contests for priority, but on the discovery of truth and its promulgation. In Mendel the great influences have been those of a teacher and investigator. As a matter of routine throughout his life he has spent two afternoons and evenings reading scientific literature in the Yale University Library. This has given knowledge of what other men in his own and in other lands are thinking. In a weekly journal club held with his graduate students, who now number twenty, this life-long habit of knowledge comes to aid beginners in the art. No one can be well balanced mentally who seeks only the latest fad, and so we find that Mendel and his school have always emphasized the influence of the older classical writers. Many brief historical reviews have been published from his laboratory as memoirs concerning the older men of science.

Recently, at Ann Arbor, I had the pleasure of meeting a band of twenty graduate students who were pupils of Professor H. B. Lewis, of the University of Michigan. And Lewis, a pupil of Mendel, was following the same procedure as his master in unfolding the story of the world's work. After this fashion the influence of Mendel's teaching radiates throughout the country and even to remote Japan. Among his pupils may be enumerated the following who hold high academic positions and are engaged in actively teaching the doctrines which he has inculcated:

Robert E. Swain (Ph.D., 1904), Stanford University.
Harold C. Bradley (Ph.D., 1905), University of Wisconsin.
Tadasu Saiki (Ph.D., 1907), director, Nutrition Institute, Tokio.
Stanley R. Benedict (Ph.D., 1908), Cornell University Medical College, N. Y. C.
Mary Swartz Rose (Ph.D., 1909), Columbia University.
Victor C. Myers (Ph.D., 1909), Western Reserve University.
John F. Lyman (Ph.D., 1909), Ohio State University.
William C. Rose (Ph.D., 1911), University of Illinois.
Howard B. Lewis (Ph.D., 1913), University of Michigan.
Ruth Wheeler (Ph.D., 1913), Vassar College.
Amy L. Daniels (Ph.D., 1914), University of Iowa.
D. Wright Wilson (Ph.D., 1914), University of Pennsylvania.
Raymond L. Stehle (Ph.D., 1915), McGill University.

In this connection it should be recalled that E. V. McCollum took his degree under the chemist Treat B. Johnson at Yale in 1906 and that he spent the academic year 1906-7 in Mendel's laboratory.

As regards his research work, there are ten bound volumes of reprints which have come from Mendel's laboratory. At the beginning he was interested especially in the metabolism of the purins. He also participated in Chittenden's classical work upon low protein diet which appeared under the title of "Physiological Economy in Nutrition." He is best known for his analysis of the value of food constituents, as shown by their influence upon the growth curves of young rats. The method was established

in a few experiments by Gowland Hopkins, and Mendel, the pioneer in this country, has developed it into a fine art. Osborne, the world's leading authority of the chemistry of vegetable proteins, had in his safe in New Haven a large variety of vegetable proteins in a state of absolute purity. From a study of the nature of these proteins the two men were led into discoveries in the vitamine field which were of great significance.

It is quite impossible to do justice to this work in a brief review. The white rat has been raised from the children's pet of our boyhood until the literature concerning it has reached heroic proportions and is worthy of an epic poem as yet unsung.

How can one tell what is a perfect food? Evidently it would be such a mixture of materials as would support normal life. The world is full of food faddists willing to advocate the most absurd propositions, but such contribute little to real knowledge. Osborne and Mendel took young rats just weaning and fed them with various mixtures to see whether they would grow as normal rats grow and later reproduce their kind. For example, the diet must contain protein for the building up of new muscle, salts for the construction of new bone, and it must have starch and fat for the fuel supply (calories) wherewith to maintain the living parts of the body.

But it is not quite so simple, and they thus expound the situation:

> According to present day criteria a *balanced ration* must represent something more than an adequate quota of calories including no less than a certain minimal proportion of protein along with inorganic salts and perhaps "roughage." The protein must be suitable in quality, so as to furnish a sufficient yield of amino-acids —the building stones of tissue cells; the inorganic salts must be both quantitatively and qualitatively appropriate; and evidently certain vitamines (including vitamine A, soluble in some of the natural fats; *e.g.*, butter fat and cod liver oil, and also vitamine B, soluble in water, which appear to be widely distributed in the active cells of plants and animals) are needed, even if the absolute quantity requisite is small.

The quality of the protein in a dietary is of great importance. Body protein is built up of about 18 different chemical compounds. Now, just as it is impossible to spell the word *p-r-o-t-e-i-n* without the letters p and n, so, too, it is impossible to build up new protein in the body without the chemical substances *lysin* and *tryptophan,* which are among the broken fragments of digestion of meat. Osborne and Mendel have found that the principal protein of wheat, gliadin, when given to young rats as the only source of protein, will not cause growth. The animals remain stunted over a long period, but when lysin is added to the diet normal growth is rapidly attained. Gliadin contains only 1 per cent. of lysin and muscle a much larger percentage. So the amino-acid mixture derived from gliadin was inadequate to build up new body proteins. The furry coat of the animal was also in bad condition, but began to grow at once when lysin was added. A thoughtful pupil of Mendel advised him to take lysin to make the hair grow on the top of his head.

Mendel showed that if rats were given a dietary containing protein, carbohydrate, fat in the form of lard, together with salts and yeast to furnish the antineuritic vitamine B, the animals grew a little while, stopped growing, developed an eye disease and perished. He found that if butter fat or cod liver oil was substituted wholly or in part for the lard, the animals developed normally. Experimenting with a thousand rats, Mendel finds that this eye disease, first noted by him, is not contagious but is a true disease of dietary deficiency due to the lack of vitamine A.

Perhaps the hearer of this review, having reached this point, will come to the conclusion that the discussion of the effect of food on rats is merely a ludicrous performance of a secluded academic mind, of no value to the great outside world. And yet we read that in the siege of Kut-el-Amara in 1916 beri-beri broke out among the British troops while they were taking their normal ration of white wheaten flour and cleared up when they were obliged to share in the more coarsely milled grain of their fellow soldiers from India; and that the disturbance of the eyes, xerophthalmia, occurred during the war among Scandinavian children fed with cereals and skimmed (fat free) milk.

Cottonseed meal is largely used as a cattle feed. Mendel and Osborne analyzed its value and showed that if it be fed with starch (which is free from water soluble vitamine) and lard (free from fat soluble vitamine) but with a proper mixture of salts, then normal growth is obtained. This means that cottonseed meal contains not only the proper protein for growth but also the water soluble vitamine B, because otherwise the rat could not have grown and would have developed the disease of beri-beri with the resulting paralysis of the limbs; and it shows that the cottonseed meal contains the fat soluble vitamine A, without which growth ceases and a redness of the eyes develops which no antiseptic treatment can benefit. Cottonseed meal is evidently a material which, if taken by a milch cow, will give the valuable fat soluble vitamine whose appearance in milk in the form of butter fat endows butter with its superiority over lard and over such vege-

table oils as olive oil or cocoanut oil, from which much of the vegetable margarine is made.

A similar analysis shows that the soy-bean, which is largely used as a cattle feed in this country and as a food for human beings in Japan, contains proteins which are adequate for promoting normal growth, an adequate amount of water soluble vitamine, and some of the essential fat soluble vitamine.

A remarkably interesting statement reveals that spinach has more water soluble vitamine B in it than whole wheat, milk or potatoes, substances known to be rich in such vitamines, and that spinach contains almost as much fat soluble vitamine A as butter does. This brings sharply before one the relation between the green things of the field and the occurrence in butter fat of fat soluble vitamine, the idea of which was first suggested by Dr. McCollum. One sees, also, how instinct triumphs when man eats olive oil, which is free from fat soluble vitamine, with cabbage, lettuce and beet tops, which are full of it.

Osborne and Mendel report how they have succeeded when others have failed in rearing chickens in confinement by giving them grain and adding fat soluble vitamine in the form of butter instead of in green food, which is ordinarily taken when the young chick is free to roam. Good growth was obtained with such a diet. Roughage was furnished in the form of blotting paper, of which a full grown bird may eat daily a piece 2 feet square.

Why should an animal fail to grow when there is no water soluble vitamine B and his diet contains only purified protein, starch, salts and butter fat? If to such a diet milk or extracts of the embryos of seeds or certain animal tissues are added, they produce growth. Yeast also furnishes the water soluble vitamine B necessary for growth.

Again, why should an animal fail to grow when there is no fat soluble vitamine A in the diet, that is to say, when the diet is made up of purified protein, starch, salts, yeast and lard? If to such a diet butter fat, egg yolk fat, beef fat or cod liver oil supplant lard, then full development takes place. Is this all a matter of improved appetite on account of a better taste of the food or does it improve the condition of the animal and therefore affect the appetite? Does the animal grow because it eats or does it eat because it grows? Osborne and Mendel incline to believe in the second explanation; that is to say, given the condition for growth, the animal eats sufficient to gain in weight.

Mendel and Osborne call attention to the fact that their milk supply was 8 times less efficient as a source of water soluble vitamine than has been reported by Hopkins for English milk. They consider it probable that when milk is diluted for the nourishment of infants the water soluble vitamines become insufficient for normal growth. Hence, the early difficulties with bottle fed babies.

But what is the sense of all this? Has not man thriven and developed true to type throughout hundreds of centuries without giving a thought to his metabolism? The secret of this lies in the power of instinct. When the Italian laborer partakes of beet tops and olive oil, as he has done through the ages, he does not know that the beet tops contain fat soluble vitamine and salts similar to those of milk. When, however, food must be prescribed by a physician, such a one should know the value of it. Alas, he often does not. But when a choice of foods is offered to either man or animals the most suitable food will usually, but not always, be taken.

To demonstrate this Osborne and Mendel offered rats their choice of superior or inferior foods. For example, two rats were offered the choice of diets, one diet containing the water soluble vitamine and the other free from it. One rat took chiefly of the food containing the water soluble vitamine and grew normally. The other for 3 weeks took the food free from this vitamine and lost in weight. It then learned to prefer the other food and grew with compensatory rapidity in the next 3 weeks, attaining almost normal growth for its age within that period. In like manner, rats will prefer diets containing casein to the same diets which are free from protein, or prefer a diet which contains a superior quality of protein (lactalbumin) to those containing an inferior protein (zein of corn).

Recent work from Mendel's laboratory shows that a diet which contains only protein and fat as the fuel giving foods, that is, one which is practically free from carbohydrate, is sufficient for excellent growth of the rat. This explains, perhaps, the predilection of the rat for cheese. Not only this, but splendid growth occurred when the diet contained 90 per cent. of protein, to which was added 5 per cent. of salts, together with alfalfa to furnish vitamine A and yeast to furnish vitamine B. This shows that true fats are not essential for growth, which can be supported at the expense of protein alone.

Mendel's influence has been potent for human welfare in the largest sense. His advice has been widely sought and his judgment of men and of affairs is highly prized. He has the faculty of kindly criticism, which is of greatest value, for, as was said by Pflüger, "Criticism is the mainspring of every advance." He has been the inspiration of hundreds of students and he has left an imperishable mark upon his day and generation.

GRAHAM LUSK

CORNELL MEDICAL COLLEGE

PRESENTATION OF THE MEDAL

TO-NIGHT the Institute of Chemists is performing through me a service, which is not only a personal one, but also by its action is establishing a new contact with workers in a neighboring field of science. Our performance to-night is clothed not only with an obvious desire to please, but also with a desire to reveal an interpretation and a spirit which pervades our organization. We believe in each other, in unanimity of understanding and effort and fair team play. It is our feeling that we record the favorable response of a large majority of the workers in our science by bestowing upon you this honor to-night. It personally gives me the greatest pleasure to be able to present you with this Medal of the Institute of Chemists in recognition of your meritorious work in your special branch of chemistry and for your broad influence as a teacher.

TREAT B. JOHNSON
PRESIDENT OF THE AMERICAN INSTITUTE OF CHEMISTS

SOME TENDENCIES IN THE PROMOTION OF CHEMICAL RESEARCH

IN recent years the civilized world has come to expect much of the sciences, and particularly of physics and chemistry. This attitude has been fostered at the outset by an awakened realization of what they have actually contributed in discoveries and inventions. The laws of nature are, in truth, the wealth of the world. Lord Moulton once remarked that without the teaching of science man blunders through life as a card player would blunder through a game of cards if he did not take the trouble to look at the cards in his hands and learn their value. The popular mind has lately become prone to believe that everything is possible to science; hence large responsibilities are likely to be thrust upon its masters.

Probably no influence or group of factors has contributed more largely to the recent exaltation of chemistry than the world war with its manifold involvements. The stress of the ominous years that witnessed a series of conflicts of hitherto unmatched enormity, the almost overwhelming necessities of readjustments in nearly every field of human activity, the depressing deprivations and the suddenly augmented demands confronting the antagonistic and even the non-combatant nations—such features served to impress in hitherto unrealized degree upon thoughtful peoples how indispensable chemistry has become to modern life in the complexity of present-day civilization. Problems of munitions and armament, of poisonous gases and optical glasses, of the supply of novel materials for use in the upper reaches of the air or in submarine depths, of food and clothing where agriculture seemed unable to meet new needs—these and innumerable other demands called for the chemist's resourcefulness in the fullest measure.

The story of many of the achievements of chemistry as revealed by war-time history has been rehearsed so often that it has become quite familiar in various details. Consequently it has been only natural for thoughtful persons to entertain the hope that this science would presently be diverted from the exigencies of strife and the distress of the state in order to be directed to the promotion of national prosperity and the betterment of the race. A distinguished chemist has remarked that "original research is in itself the most powerful weapon that has ever been or ever can be wielded by mankind in struggling with the great problems which nature offers on all sides for solution." (Meldola.) This thought has become the ardent belief of eager multitudes. The word research has become an expression to conjure with; a term used not infrequently without any adequate appreciation of its fundamental implications. Thus it has come about that science has been exposed upon an elevated pedestal to the fullest view of an over-awed public. "From time to time," a sympathetic writer has pointed out, "so many marvels have been suddenly sprung upon us in the past which have owed their birth to research carried on in silence in laboratories and the like that the general public is quite ready to treat such homes of research as mysterious workshops, the methods and aims of which are beyond them, but from which great discoveries may at any moment arise. It looks forward with hope to these future discoveries and it feels too much in awe of the secrets of science to desire to control or criticize the methods by which they are arrived at." (Moulton.)

The chemist himself, on the other hand, knows all too well that there is no royal road to untrammeled success in his domain. Across the fields that he traverses there are liable to be barriers of the most varied sorts that may impede or even completely stop his progress. He is not protected against the stumbling blocks encountered in other walks of life. Men of science realize that they can not answer the riddles of life or solve the problems of industry on command; yet the larger public is beginning to assume that in the scientific disciplines a little enthusiasm and well-directed energy will inevitably furnish the required solutions. The man-on-the-street sees the modern engineer constructing bridges of hitherto unattained proportions; he watches the skyscraper rising under the builder's guiding hand to surprising heights; and he observes the harnessing

table oils as olive oil or cocoanut oil, from which much of the vegetable margarine is made.

A similar analysis shows that the soy-bean, which is largely used as a cattle feed in this country and as a food for human beings in Japan, contains proteins which are adequate for promoting normal growth, an adequate amount of water soluble vitamine, and some of the essential fat soluble vitamine.

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Mendel and Osborne call attention to the fact that their milk supply was 8 times less efficient as a source of water soluble vitamine than has been reported by Hopkins for English milk. They consider it probable that when milk is diluted for the nourishment of infants the water soluble vitamines become insufficient for normal growth. Hence, the early difficulties with bottle fed babies.

But what is the sense of all this? Has not man thriven and developed true to type throughout hundreds of centuries without giving a thought to his metabolism? The secret of this lies in the power of instinct. When the Italian laborer partakes of beet tops and olive oil, as he has done through the ages, he does not know that the beet tops contain fat soluble vitamine and salts similar to those of milk. When, however, food must be prescribed by a physician, such a one should know the value of it. Alas, he often does not. But when a choice of foods is offered to either man or animals the most suitable food will usually, but not always, be taken.

To demonstrate this Osborne and Mendel offered rats their choice of superior or inferior foods. For example, two rats were offered the choice of diets, one diet containing the water soluble vitamine and the other free from it. One rat took chiefly of the food containing the water soluble vitamine and grew normally. The other for 3 weeks took the food free from this vitamine and lost in weight. It then learned to prefer the other food and grew with compensatory rapidity in the next 3 weeks, attaining almost normal growth for its age within that period. In like manner, rats will prefer diets containing casein to the same diets which are free from protein, or prefer a diet which contains a superior quality of protein (lactalbumin) to those containing an inferior protein (zein of corn).

Recent work from Mendel's laboratory shows that a diet which contains only protein and fat as the fuel giving foods, that is, one which is practically free from carbohydrate, is sufficient for excellent growth of the rat. This explains, perhaps, the predilection of the rat for cheese. Not only this, but splendid growth occurred when the diet contained 90 per cent. of protein, to which was added 5 per cent. of salts, together with alfalfa to furnish vitamine A and yeast to furnish vitamine B. This shows that true fats are not essential for growth, which can be supported at the expense of protein alone.

Mendel's influence has been potent for human welfare in the largest sense. His advice has been widely sought and his judgment of men and of affairs is highly prized. He has the faculty of kindly criticism, which is of greatest value, for, as was said by Pflüger, "Criticism is the mainspring of every advance." He has been the inspiration of hundreds of students and he has left an imperishable mark upon his day and generation.

GRAHAM LUSK

CORNELL MEDICAL COLLEGE

PRESENTATION OF THE MEDAL

TO-NIGHT the Institute of Chemists is performing through me a service, which is not only a personal one, but also by its action is establishing a new contact with workers in a neighboring field of science. Our performance to-night is clothed not only with an obvious desire to please, but also with a desire to reveal an interpretation and a spirit which pervades our organization. We believe in each other, in unanimity of understanding and effort and fair team play. It is our feeling that we record the favorable response of a large majority of the workers in our science by bestowing upon you this honor to-night. It personally gives me the greatest pleasure to be able to present you with this Medal of the Institute of Chemists in recognition of your meritorious work in your special branch of chemistry and for your broad influence as a teacher.

TREAT B. JOHNSON
PRESIDENT OF THE AMERICAN INSTITUTE OF CHEMISTS

SOME TENDENCIES IN THE PROMOTION OF CHEMICAL RESEARCH

IN recent years the civilized world has come to expect much of the sciences, and particularly of physics and chemistry. This attitude has been fostered at the outset by an awakened realization of what they have actually contributed in discoveries and inventions. The laws of nature are, in truth, the wealth of the world. Lord Moulton once remarked that without the teaching of science man blunders through life as a card player would blunder through a game of cards if he did not take the trouble to look at the cards in his hands and learn their value. The popular mind has lately become prone to believe that everything is possible to science; hence large responsibilities are likely to be thrust upon its masters.

Probably no influence or group of factors has contributed more largely to the recent exaltation of chemistry than the world war with its manifold involvements. The stress of the ominous years that witnessed a series of conflicts of hitherto unmatched enormity, the almost overwhelming necessities of readjustments in nearly every field of human activity, the depressing deprivations and the suddenly augmented demands confronting the antagonistic and even the non-combatant nations—such features served to impress in hitherto unrealized degree upon thoughtful peoples how indispensable chemistry has become to modern life in the complexity of present-day civilization. Problems of munitions and armament, of poisonous gases and optical glasses, of the supply of novel materials for use in the upper reaches of the air or in submarine depths, of food and clothing where agriculture seemed unable to meet new needs—these and innumerable other demands called for the chemist's resourcefulness in the fullest measure.

The story of many of the achievements of chemistry as revealed by war-time history has been rehearsed so often that it has become quite familiar in various details. Consequently it has been only natural for thoughtful persons to entertain the hope that this science would presently be diverted from the exigencies of strife and the distress of the state in order to be directed to the promotion of national prosperity and the betterment of the race. A distinguished chemist has remarked that "original research is in itself the most powerful weapon that has ever been or ever can be wielded by mankind in struggling with the great problems which nature offers on all sides for solution." (Meldola.) This thought has become the ardent belief of eager multitudes. The word research has become an expression to conjure with; a term used not infrequently without any adequate appreciation of its fundamental implications. Thus it has come about that science has been exposed upon an elevated pedestal to the fullest view of an over-awed public. "From time to time," a sympathetic writer has pointed out, "so many marvels have been suddenly sprung upon us in the past which have owed their birth to research carried on in silence in laboratories and the like that the general public is quite ready to treat such homes of research as mysterious workshops, the methods and aims of which are beyond them, but from which great discoveries may at any moment arise. It looks forward with hope to these future discoveries and it feels too much in awe of the secrets of science to desire to control or criticize the methods by which they are arrived at." (Moulton.)

The chemist himself, on the other hand, knows all too well that there is no royal road to untrammeled success in his domain. Across the fields that he traverses there are liable to be barriers of the most varied sorts that may impede or even completely stop his progress. He is not protected against the stumbling blocks encountered in other walks of life. Men of science realize that they can not answer the riddles of life or solve the problems of industry on command; yet the larger public is beginning to assume that in the scientific disciplines a little enthusiasm and well-directed energy will inevitably furnish the required solutions. The man-on-the-street sees the modern engineer constructing bridges of hitherto unattained proportions; he watches the skyscraper rising under the builder's guiding hand to surprising heights; and he observes the harnessing

of mighty waters to do service unto man. Hence he expects the chemist also to work wonders on demand, all too often not appreciating that there is an utter lack of the fundamental information upon which the desired effort must be based. Incidentally there is too little realization of the fact that contributions of large practical importance have not infrequently been the by-product of research rather than the immediate goal of the investigator.

One can not always anticipate results in science. This significant truth is well illustrated in the history of the discovery of the X-rays by Röntgen. He was not searching for a method of penetrating the interior of the body with light; rather following the studies of Lenard and Herz he was engaged in consideration of radiation from the seat of electric discharge. Röntgen's contribution was the outcome of a chance observation. The fortuitous features of it have been depicted well by Bragg:

> The rays were discovered in 1896. Suppose that in 1894 the surgical profession had asked if science could furnish the powers just described. We are trying to reverse what actually happened, and to see if things could have taken place as they did "Through the Looking Glass." Now in the first place we can not imagine how the profession would come to think of making such a request. No one at that time had ever conceived the possibility of being able to do a thing which was uncommonly like seeing through a door. It would have been classed with vision of that penetrating kind if it had been proposed; and considered as incompatible with known facts. So indeed it was, if its accomplishment was to be some new act of ordinary vision; but the solution came in an entirely different fashion. The problem was solved indirectly, as so often happens; and for this very reason its solution could not have been expected or asked for. Not only may it be asked why this particular request should be chosen in preference to any other of a thousand requests which could be imagined; but it may be asked how it is to be expected that the request should be conceived at all. There was nothing to make any one think of asking for such a thing as x-rays. (Bragg, W. H.: "Physical Research and the Way of its Application." In "Science and the Nation." Cambridge, 1917, p. 30.)

"It is impossible," Bragg concludes, "to conceive of progress being made in this order, which is the reverse of the natural course."

The vaunting of the contributions of science to the welfare of nations, the story of how its progress has "revolutionized our civilization as to its methods and opportunities, as well as advancing our knowledge of the wonderful processes of nature," bring immense gratification to the devotees of science. The satisfaction in accomplishment is compelling. However well the scientist himself may realize his limitations, the same modesty of outlook does not characterize his latter day admirers. One may seriously inquire, therefore, whether some danger to scientific endeavor is not hidden in the current great expectations. In his essay on "Vain-Glory," Francis Bacon quoted the French proverb: "Beaucoup de bruit, peu de fruit": Much bruit, little fruit. Need we not fear lest failure of science to achieve in the ways now so confidently expected may prove to be a boomerang? The persistent worker in the laboratory is prepared to face temporary defeats with equanimity; they do not retard his efforts, but usually stimulate him to renewed endeavor. He realizes that research is essentially diligent, protracted effort. On the other hand, the public, the momentary admirer and supporter of the scientist, is not similarly inured to the inevitable shortcomings of experimentation. The public craves to-day, more than ever before in the history of science, a prompt and uncompromising answer to innumerable unsolved questions. It does not complacently brook the failures that may attend great expectations. Disappointment turns to disillusionment and then to distrust. When this occurs science is in danger of losing many an ardent admirer and perhaps not a few staunch supporters.

Scientists have repeatedly chafed under the indifference of nations to which they belong; they have clamored for respectful recognition if not actually for financial help. A sympathetic audience having at length been secured from those prominent in our national affairs, the advantage so laboriously gained must not be lost through vain boasting or the persistence of misconceptions as to what science can really do. If some nations were remiss before the war in cultivating chemistry, the pendulum of post-war enthusiasm for the neglected science may swing too far in the direction of expected immediate achievement before it acquires its normal rhythm.

Inasmuch as the expected perfection may fail of attainment in even the most ardently prosecuted scientific research, does not a duty devolve upon the workers to avert a debacle of interest in their undertakings? Joyous as it may be to acclaim the triumphs of science, is it not also desirable to educate the auditors with respect to the ways and means, the trials and errors, by which alone continued and permanent contributions are assured? The recognition that knowledge is finite, that progress involves change, that traditional beliefs are subject to revision, needs to be promoted. The public should be made to realize that the scientist is one of that large group of persons compelled at times to utter the truthful words: "I am wrong." In this connection a recent comment by Cattell is pertinent:

> If it is asked how the scientific man knows the truth, the answer is that he does not. He makes approxima-

tions and the bank of his knowledge is solvent so long as it honors his drafts. The Euclid-Newton bank honored until recently all the drafts that were drawn on it. It appears that it may fail to do so for some little ones; if this proves to be the case then our physical universe must be revised or discarded. It is equally true that no social system, no political theory, no religious creed, can be maintained when it is not in accord with science. The methods of science, slowly gaining in force and volume through the centuries, will in the end bring truth and reason into all our beliefs and actions. At least that is the hope of the world, for we can not rely on inherited instincts to meet situations always increasing in complexity. (Cattell: *The Scientific Monthly*, March, 1927, p. 200.)

Huxley once remarked that "what people call applied science is nothing but the application of pure science to particular classes of problems." It is indeed futile and undesirable to attempt to set distinctions between such categories of science. Nevertheless it may not be amiss to stress again and again the desirability of preserving an unfaltering interest in what are often referred to as fundamental problems. Whether it be in chemistry, physics or the biological sciences, the urge to "make good" is liable to lend an unwarranted emphasis upon achievements that are immediately practical. Their glitter and the enthusiasm that they create sometimes promote the abandonment of the arduous search for fundamentals. The secrets of the atom, the mysteries of the cell, the dynamics of living processes deserve to be revealed regardless of any immediate exploitation thereof in every-day life.

Among the far-reaching influences of the world war upon chemistry the consolidation of talent in the effort to solve pressing problems deserves special mention here. The supreme desire for victorious success brought about a collaboration of many chemists, drawn from diverse fields, in investigative work. The outstanding effectiveness in many instances of cooperative undertakings directed toward projects of large moment to the national welfare has challenged attention. The mobilization of the scientific workers appeared to be the realization of the adage that "two heads are better than one." The outcome of the war-time plan of combined investigative effort was so gratifying that the chemical fraternity presently began to debate whether so-called cooperative research could not profitably replace the more conventional mode of isolated individual undertaking. Numerous essays have extolled the virtues of communal effort, even ridiculing the stupidity of the scientific world in neglecting so long the obvious advantage of joint labors directed to a common end. The arguments have been supported by citations from the experiences of the research laboratories of a few large industrial enterprises.

Here again one may foresee a possible menace through preponderance of enthusiasm—this time on the part of chemists themselves—for war-time advantages. Patriotic performance is, after all, a somewhat exceptional expression of human nature. Personal ambition is the powerful directive force that accomplishes much good even when national distress is not involved. The urge to succeed is a worthy impelling motive for most persons of intelligence. In ultimate analysis the man, not the machine, invariably is responsible for progress.

It becomes a duty, therefore, to conserve the individual quite as much as to promote the group. The history of chemistry gives abundant illustrations of the importance of this thesis. Joint undertaking often brings brilliant results. But the human mind is not gregarious, nor is its possessor always readily adjusted to strictly cooperative enterprise. It is also a real service to save the exceptional man, enabling him to develop that individuality which is unbiased by preconceived notions and unhampered by the dominance of an insistent fellow-worker. May not the oft mentioned successful chemical research in some of the industries represent the advantage of community of interest rather than strict cooperation in undertaking? Competition in research is by no means always wasted effort, for it sometimes ends in verifying important deductions as well as serving to correct error and point out new viewpoints. Cooperative research needs no defender at the present time. It has become the cry of the hour. The preservation of individuality is the more likely to suffer neglect in a modern democracy of science. We are partisans as men, not as students of science.

Like other branches of science, chemistry has experienced marked changes in the favored technique of experimentation as well as a succession of altered attitudes with respect to what constitute the foremost topics of investigative moment. Latterly a hitherto unequalled interest has been centered in the importance of the quantitatively minute. This applies, for example, to the identification and study of substances that occur in very small quantities; likewise to measurements in which they are involved. The considerations of radioactive materials, of organic and inorganic catalysts, of hormones and vitamines bear witness to the prevailing enthusiasms. It has become quite customary to deal with reactions in which "parts per million" are involved. In a person of 70 kilograms of body weight a few milligrams of iodine may become responsible for the difference between nutritive well-being and profound metabolic upset. This means a health-promoting effect of the indispensable element in quantities of less than one part per million. An excess of a few hundredths of a per cent. of glucose in the blood

leads to glycosuria. A variation of a few milligrams above or below the usual calcium content of the entire circulating fluid spells disaster. On such slender threads does the chemical balance of the human organism hang. These few illustrations are selected from my own department of study; they can readily be duplicated from all of the subdivisions of chemistry.

As might be expected, appropriate refinements of analysis have been introduced to meet the new situations. Micro-analysis has attained an unanticipated popularity. A few milligrams of an organic compound now suffice for the determination of an empirical formula; a few drops of blood or tissue fluid may furnish important indications of the chemical changes in metabolism. The micro methods have won their way rapidly into the chemical laboratory of to-day; and with them has come a greater readiness to attack unsolved problems of composition and behavior even where quantities of material available were once considered hopelessly inadequate.

The importance of "little things" in chemistry, the dominant significance of the minute in many chemical processes, greatly enhance the desirability of studying the potent rarer substances. In the effort to identify them the micro methods, frequently indirect in their implications, may leave the chemist in the lurch. The possession of a small sample of an impure derivative may permit only the crudest sort of examination that is quite as likely to tantalize as to reward. I venture to prophesy a growing employment of "large scale" operations in departments of chemical research that have scarcely outgrown the exclusive use of the test tube and the beaker for their major reactions. One can herald with a feeling of real assurance many future successes arising from the application of large scale chemical procedures. The inorganic chemist has long realized that the identification of the radioactive elements resulted only through the use of tons of ores in which they are hidden away. It remained for the biochemists, often engaged without success in studying the nature of the potent iodine-containing substance of the thyroid gland, to observe Kendall in this country and Harrington in England apply the processes of separation and purification to hundreds of pounds—not a few grams or kilograms—of animal tissue before the worthwhile discoveries regarding thyroxin were made. Willstätter's classic researches on chlorophyll called for the use of enormous amounts of green leaves. The quest of the antirachitic vitamine—vitamine D—has already involved the saponification of a few tons of cod liver oil without as yet yielding in a state of requisite purity sufficient of the potent factor to establish its actual chemical nature beyond question. The epinephrin of the adrenal medulla remained elusive until it was prepared in adequate amounts for critical study. Unless a wealth of pancreative gland is made available for the separations, the complete story of the chemistry of insulin is not likely to be written. How greatly our knowledge of glutathione and the ergothionine of the blood would have been enhanced if large scale operations had been initiated to secure them in that abundance which the industrial chemist often enjoys in his studies of new compounds. The chemistry of both animal and plant cells—materials rich in unknown numbers of unidentified substances some of which are presumably of large biological significance—awaits the employment of factory-like operations affording better opportunities to attempt the difficult separations of unrecognized compounds. Such undertakings require large support as well as real talent; they also hold out large promises of achievement in fields where the less pretentious operations have thus far yielded scanty returns. Cell chemistry is destined to emerge from the microscopic stage of investigation.

The scientific consideration of the laws of nature as they are exemplified in the properties and combinations of the elements has gradually become departmentalized, so to speak, in somewhat peculiar ways in chemistry. It has never been easy to draw a hard and fast line of division between physics and chemistry. Their dominions overlap here and there; at least there is a border region where the primary interest involved is difficult of classification. Chemistry, in turn, has become organized into a group of subdivisions representing convenience of administration far more than any logical distinctions that would justify independent treatment of them. Inorganic chemistry, organic chemistry and physical chemistry, not to mention the more pragmatic subdivisions, are being promoted in a degree of isolation that has undeniable drawbacks. For the moment physical chemistry formulated with new viewpoints, employing novel methods, and armed with all the enthusiasm that belongs to a vigorously growing venture seems to be leading in the attack upon the current problems. Its contributions are undeniable. Physical chemistry has gained a dominant position in the chemical endeavors of the present generation; yet a critical observer may well wonder whether part of the advance has not consisted in the application of a revised nomenclature, in new formulation of old experiences, in more courageous entrance into poorly cultivated domains. The progress under the banner of physical chemistry has been more largely that of the natural evolution of a science than of any revolutionary approach to its besetting puzzles. The world will welcome the gains that any branch of chemistry

promises to bestow; but it would indeed be unfortunate if the momentary enthusiasm for one department were to obscure the deserts of the other subdivision.

This thought may properly merit emphasis at the present moment when the prestige and popularity of organic chemistry seem to be eclipsed by the younger physical chemistry, perhaps even to the extent of being in danger of real neglect by the oncoming students. Shall they forget such "marvelous achievements of theoretical reasoning and of practical skill" as the commercially successful synthesis of indigo from coal tar products at a time when, as Pope remarked, the manufacture of natural indigo was carried out by methods which the Pharaohs might have criticized as conservative? Can we afford to overlook the fact that the organic chemist deals with manifold substrates which involve the surface relations, intermolecular forces, hydrogen ions and chemical equilibria of physical chemistry? Surely the day of the organic chemist has not yet passed. Physiological chemistry, about which I may perhaps speak with greater assurance, is feeling the effects of the prevailing prejudice created by the new domination. A survey of some of the biochemical literature gives the impression that the broad field of the detailed composition and function of living structures is being envisaged from a somewhat narrow angle—one in which colloidal phenomena, ionic equilibria, permeability factors, osmotic and surface forces furnish the chief basis for the outlook. Yet we remain grossly ignorant as to the actual chemical composition of most of the tissues and fluids of both plants and animals. A constructive inroad into these unexplored recesses, an endeavor to discover the unrecognized organic compounds out of which the living cell, the morphologic background of protoplasm, the basis of life, is built up can not fail to be worthwhile. It calls for superior chemical talent; for something more than the ability to analyze products in the conventional terms of protein, fat, carbohydrate and ash. Cytoplasm and nucleus, chromosomes and vacuoles are little more than words to the biochemist. Here is hidden much temporarily neglected wealth remaining to be uncovered.

This appeal for a rejuvenation of interest in what may be regarded as one phase of organic chemistry should not be interpreted in any way as even the slightest disparagement of the rival branches. It is made, rather, with the purpose of showing the limitations of exclusive "fashions" in chemical research; it is uttered with the hope of encouraging a greater integration of the varied aspects of chemistry that now receive isolated independent consideration. Perhaps nothing could be more conducive to this end than a reform of the current methods of teaching chemistry. The approaching centenary of the first artificial synthesis of a "product of life," Wöhler's production of urea, might not only be a reminder that so-called vital forces are dispensable, but also mark the broader recognition of the essential unity of chemistry.

In the discussion of my major theme a few comments on the preparation of the investigator and the training for chemical research may not be out of place. Among the criticisms to which the academic world is now-a-days being subjected one hears frequently the charge that memory training plays a rôle too exclusively. The late Sir James Mackenzie, an eminent physician familiar with the experimental method, supported the complaint in words that his biographer has described as "the only 'revenge' which Mackenzie ever permitted himself against the educational system by and through which he had suffered." With his own experiences in mind he wrote:

> There are two very distinct qualities of the human mind: memory, and the power of reasoning. The earliest to be developed is that of memorizing, and this can be cultivated with great ease. The power of reasoning is quite different, although, no doubt, memory takes a part. When we look at a great number of students, we discover that this power of memory is greatly developed in a few, and all our educational methods are devoted to its cultivation. Examinations are specially contrived for the purpose of discriminating those with the best memories, and to them all the honors and prizes are given.
>
> The individuals who, on the contrary, possess more of the power of reasoning than their fellows, receive no consideration. There are minds which have a difficulty in remembering isolated facts, but if these facts are related in some consecutive manner, they can not only remember them, but also appreciate their bearing on one another. But this type of mind is slow in acquiring knowledge, and in our present-day methods of education less and less encouragement is given to this type of student. His peculiar powers are never developed, and their presence is never suspected.
>
> "The outcome of the teaching of to-day is to hail the student with superior powers of memorizing as the brilliant student, and the one with the great future. The consequence is that his path from the outset is made easy for him. Bursaries and scholarships fall to his share, and before he has acquired any experience, he is appointed to a teaching post. In the absence of any knowledge acquired from the results of his own observations, he is forced to teach that which he was himself taught, and, as he can not discriminate between truth and superstition, he hands both on to his students. As years pass he comes to believe what he has taught is true and may even grow impervious to new ideas which are contrary to the beliefs he has been expounding."

(Wilson, R. M.: "The Beloved Physician, Sir James Mackenzie." New York, 1926, p. 24.)

A reaction against the type of education that Mackenzie thus assailed has asserted itself through the wide-spread introduction of the so-called "laboratory method" of teaching in which the student is being left more and more to his own devices. This is the essence of the inductive method. It promotes keenness of observation and critical judgment; it presupposes the open mind. As so often happens with our enthusiasm for the new, the inductive method has been driven in some places beyond its greatest effectiveness. Freedom to start on a voyage of discovery in the student laboratory does not invariably lead to the desired shores. The ways of the pioneer discoverers have usually been long, and their progress slow. After all, there are facts, multitudes of facts, long since described, which could be rediscovered by each generation of students if this laborious process seemed worth while. Why require it?

Without a background of facts thinking becomes a difficult, if not a futile task. A rich store of fundamental facts is the indispensable equipment of what Pasteur so expressively termed the "prepared mind." Many persons are privileged to make chance observations; only the prepared mind profits by them. "Curiosity alone," Bigger has written, "will not make more than a laboratory dabbler, a dilettante of science. Many other qualities must be added to make a worthy researcher. Knowledge, both wide and deep, of his subject and of related sciences is needed to fit him for his work and to help him to surmount the difficulties with which the paths of science are so liberally sprinkled." (Bigger, J. W.: Irish J. M. Sc., Jan. 1927, *6*, 19.) Didactic instruction, so largely discredited at the present time, may yet regain some measure of favor as an economical procedure for ascertaining essential facts. The test tube and the reagent bottle are not the alpha and omega of a chemist's training.

Waste of time is no more tolerable in student days than in after life. The candidate for a career in research should be spared from wasting time in useless laboratory work. Peabody recently remarked that "the popular conception of a scientist as a man who works in a laboratory and who uses instruments of precision is as inaccurate as it is superficial, for a scientist is known, not by his technical processes, but by his intellectual processes; and the essence of the scientific method of thought is that it proceeds in an orderly manner toward the establishment of a truth." (Peabody, F. W.: J. A. M. A., March 19, 1927, *88*, 877.) The student may often be started on an effective course far earlier than our standardized school systems now permit. A recent writer on school education has remarked:

> The teaching of science in our schools, which has been improving so slowly during the last twenty years must be stimulated and some scientific method of selecting and coordinating the science subjects to be taught must be introduced. It would seem rational that mathematics should be the earliest science dealt with, followed by physics, chemistry and mechanics, and that wholly subordinate importance should be attached to the biological sciences, because the elementary stages of these latter subjects are necessarily largely descriptive and insusceptible to broad treatment as illustrative of scientific reasoning and method. That our schools do not keep in view the fundamental scheme which correlates all the natural sciences is obvious; it becomes especially evident when the large amount of time often devoted to botany is contrasted with that allotted to physics and chemistry. (Pope, W. J.: "The National Importance of Chemistry." In "Science and the Nation," Cambridge, 1917, p. 20.)

Appropriate coordination of preparatory studies is an important desideratum in the early training of the successful investigator; for it will help him to know things and forces not in isolated instances, but in their truer natural relations.

Chemical research has become a dignified profession that has abundantly justified itself. Those who are devoted thereto have the duty of encouraging its efforts, of safeguarding its future, and of promoting its personnel. Critical comments, such as some of the foregoing remarks involve, should not be construed as an outburst of pessimism. Change is the essence of progress which even the optimist may endeavor to safeguard.

LAFAYETTE B. MENDEL

YALE UNIVERSITY

WILLIAM MARC CHAUVENET

WILLIAM MARC CHAUVENET was born in the U. S. Naval Academy at Annapolis, Maryland, March 4, 1855. His father, the distinguished astronomer and mathematician, was at that time superintendent of the U. S. Naval Academy at Annapolis. William Chauvenet died in St. Louis on December 11, 1926, in his seventy-second year. When his father was appointed first chancellor of Washington University, the family moved to St. Louis. William was educated at the Smith Academy and the Wabash University in St. Louis. After leaving college he was appointed as an assistant on the U. S. Geological Survey in 1880 and was under Raphael Pumpelly at Newport, R. I. After remaining there a year or two he was ordered to report to the professor of geology

and mineralogy at the University of Wisconsin, Roland D. Irving, who sent him to examine the geological formations on the North Shore of Lake Superior. He was engaged on this work in this locality for two years, living in a tent with Indian guides. His experiences on this work were most interesting. About 1883 or 1884 he went into partnership with his older brother Regis, who had a laboratory at Seventh and Pine Streets in St. Louis. The firm name was Regis Chauvenet & Brother. When his brother Regis went to Colorado as president of the State School of Mines at Golden, William remained in St. Louis and although Regis withdrew in a few years from the firm, William ran the laboratory under the old name of Regis Chauvenet & Brother until his death. William made many examinations of mines in the United States and deposits at Trinidad and those on the Orinoco River in South America. He was a most versatile man and, aside from his mining and chemical work, was a poet of no ordinary ability and his water color paintings were excellent. His circle of friends and acquaintances was world wide, and no more charming companion could be found than he.

HERMANN VON SCHRENK

SCIENTIFIC EVENTS

JUBILEE OF THE PHYSIOLOGICAL SOCIETY[1]

THE Physiological Society (Great Britain) celebrated its jubilee by a dinner in London on May 13. The society was founded in 1876, and its jubilee was in 1926, but owing to the amount of business resulting from the purchase of the *Journal of Physiology* from Mrs. Langley, it was not possible to arrange for the celebration in that year. The four surviving original members of the society are: Sir David Ferrier, Sir E. Ray Lankester, Sir W. Thiselton-Dyer and Sir E. Sharpey-Schafer, who presided at the dinner. The toast of the society was proposed by Major Elliot, parliamentary under-secretary for health for Scotland, who pointed out the practical benefits that had been obtained as the result of physiological research. The chairman, Sir E. Sharpey-Schafer, in his reply, described how the society was founded as a dining club to defend the members against the attacks of the anti-vivisection societies, and it thus represented the only good that had resulted from the anti-vivisection agitation. Later in the history of the society it became customary to visit one laboratory or another before the dinner, to see demonstrations of work in progress. The development of the society is shown by the present practice, namely, that demonstrations have precedence over other communications, and that all business, except that of a special general meeting summoned for some specific purpose, is transacted after the dinner which is held with most meetings of the society.

Sir Charles Sherrington proposed the toast of the guests, with which was associated the names of Sir Ernest Rutherford, Professor G. Fano, of Rome, Professor Gley, of Paris, and Viscount Knutsford. Sir Ernest Rutherford pointed out the relation between physics and physiology, in which a physical instrument was perfected for some special recording device such as the Einthoven string galvanometer, and was afterwards used in physical laboratories because of its delicacy and accuracy. He recommended a training in physics as a preliminary to research in physiology. Professor Fano made a delightful congratulatory speech in English and Professor Gley conveyed the best wishes of his French colleagues in a stirring address in French. Viscount Knutsford referred particularly to the gain to humanity by Schafer's method of artificial respiration, and to the Research Defense Society, which does its best to educate the intelligent public as to the benefits obtained from experiments on animals. He suggested that physiologists ought to do their share by joining that society, by furnishing accurate information and by speaking on the subject. Professor Leonard Hill proposed a vote of thanks to the chairman, who, he pointed out, had sent apostles to Ireland, Canada, Australia, New Zealand, South Africa, United States, China and many other parts of the world to promulgate the doctrines of physiology. On May 14 there was an ordinary meeting of the society in Cambridge, with the business dinner meeting in Trinity College. On the following day Professor and Mrs. Bareroft gave a garden party in the fellows' garden of King's College, kindly lent by the provost and fellows of the college.

[1] From *Nature*.

AN ENTOMOLOGICAL SURVEY OF THE PACIFIC

THE conditions on many of the islands of the Pacific are rapidly changing. Mountains which were formerly covered by native forests are being denuded, or the original vegetation is being replaced by introduced species. With the changing conditions in plant life and the increase of commerce there are accompanying changes in the insect fauna. If entomologists are ever to know the insects of the Pacific area no time can be lost. It would be difficult to overestimate the importance of a thorough knowledge of the native insects of this region either from a purely scientific or an economic point of view.

An entomological survey of the Pacific is being

planned by a group in Hawaii. The Bishop Museum and the Hawaiian Sugar Planters Association have each pledged financial support over a period of five years, and it is likely that the Association of Hawaiian Pineapple Canners will join with them. A local committee has been organized with Dr. C. M. Cooke, of the Bishop Museum, as chairman, assisted by John E. Russell, chairman of the experiment station committee of the Hawaiian Sugar Planters Association, Charles R. Hemenway, chairman of the board of regents of the University of Hawaii, Charles S. Judd, executive officer of the Board of Agriculture and Forestry, and A. L. Dean, director of the Experiment Station of the Association of Hawaiian Pineapple Canners. This committee, no one of whom is an entomologist, has secured Dr. C. F. Baker, dean of the Agricultural College of the University of the Philippines, to be the scientific head of the survey. Dr. Baker will have his headquarters in Honolulu. The present plans contemplate one or more field parties which will send all collections to Honolulu where some material will doubtless be identified, but much of it will be sorted and sent to specialists to work up. According to the present plan Dr. Baker will devote all his time during the first year to the work of the survey, and in subsequent years divide his time between that and the University of Hawaii.

A. L. DEAN

ALASKAN EXPLORATIONS

THE U. S. Interior Department has announced that plans have recently been approved for further geologic and topographic surveys by the U. S. Geological Survey during the coming field season in the Alaska Range in the vicinity of Mount Spurr. This is part of one of the large unexplored regions of Alaska lying between the head of Cook Inlet and the Kuskokwim basin. Although its eastern edge borders on the coast, the rugged glaciated mountains that occupy most of the area are almost untraversable and are separated from the shore by a high marshy lowland that is difficult to cross and that so far has discouraged exploration of the inland region.

This project is part of the general program of mapping our northern territory that has been carried forward by the Geological Survey for the last 30 years as rapidly as funds and personnel have been available and that has resulted in the publication of accurate maps and definite knowledge of the mineral resources of a large part of Alaska. The object of this party is to map as much as possible of the tract of country lying between the region north of Mount Spurr, which was surveyed during the field season of 1926, and the areas covered by earlier surveys in the vicinity of Tuxedni Bay and Lake Clark. The work will be done by a surveying party in charge of S. R. Capps, geologist, with R. H. Sargent, topographic engineer, and four camp hands. The party will probably reach Anchorage early in June and then, together with the necessary pack horses, supplies and provisions for four months, will embark on a launch and a barge, proceed to the west shore of Cook Inlet, and land on the beach near the West Foreland. From that time as long as forage for the horses lasts or until snow flies, which will probably be about the middle of September, the party will be entirely out of communication with the rest of the world and will travel into the mountains, carrying with them their entire store of supplies and equipment and mapping the land forms and geology as they go.

It is expected that as a result of this expedition information will be obtained concerning several thousand square miles of the public domain, about which at present almost nothing is known.

DEDUCTION OF TRAVELING EXPENSES TO SCIENTIFIC MEETING FROM TAXABLE INCOME

PROFESSOR A. SILVERMAN, head of the department of chemistry at the University of Pittsburgh, has won a decision from the Federal Board of Tax Appeals making traveling expenses to conventions deductible as expenses ordinary and necessary to the teaching profession. The text of the decision follows:

UNITED STATES BOARD OF TAX APPEALS

ALEXANDER SILVERMAN, Petitioner,

v.

COMMISSIONER OF INTERNAL REVENUE, Respondent.

Docket No. 10389. Promulgated May 12, 1927.

Amounts expended by petitioner, a professor of chemistry and a member of the faculty of the University of Pittsburgh, in connection with the carrying on of his profession, in attending scientific meetings and conventions, constituto an ordinary and necessary business expense.

S. Leo Ruslander, Esq., and A. E. James, Esq., for the petitioner.

D. D. Shepard, Esq., for the respondent.

This proceeding results from the determination of a deficiency in income tax for the year 1921 of $55.88 by reason of disallowance of a deduction of $558.75 claimed by petitioner as ordinary and necessary business expense for the taxable year in carrying on his duties as a professor of chemistry and a member of the faculty of the University of Pittsburgh. The facts are found as stipulated.

FINDINGS OF FACT

The petitioner is a resident of Pittsburgh, Pennsylvania. He keeps his accounts on the basis of actual receipts and disbursements. Prior to and during the year 1921 he was

at the head of the Department of Chemistry of the University of Pittsburgh, with the title of Professor of Chemistry, and has for the past twenty-one years been a member of the faculty of that university.

As the head of the department of chemistry, it was expected of and incumbent on him as such to keep abreast in his particular field of work and in touch with other scientists in the same field, which was done among other ways by the preparation and publication of papers, by the reading of technical periodicals and by the attendance at such conventions where consideration of subjects of a scientific nature were presented and discussed.

The petitioner attended like conventions prior to 1921, did so attend in 1921 and has since so attended, such action on his part being expected and necessary, as it was of others similarly employed at the university, for the purpose of keeping thoroughly informed in his field of work and in touch with other scientists, and in order to advance the interests of the university, though his contract of employment does not specifically make mention of any such activities and there was no provision made for repayment to him of expenses so incurred.

In the taxable year mentioned, petitioner, for the purposes and objects mentioned, attended the American Ceramic Society at Columbus, Ohio; the American Chemical Society at Rochester, New York, and a meeting of the same society in New York City, and, in so doing, incurred and paid reasonable and actual expenses for hotel rooms, meals and railroad fare to and from said conventions, the sum of $558.75, no part of which sum has been repaid him by the university, nor by any person, society or organization, whatever. Each of the three trips mentioned occupied a week and petitioner was in attendance the full length of each convention, and for each convention prepared and delivered a paper or papers. By reason of the fact that petitioner was a member of the council of the American Chemical Society, he was in attendance prior to the general convention seasons.

OPINION

LITTLETON: The Board has held that expenditures of the character and made under circumstances involved in this proceeding are deductible as ordinary and necessary business expense. M. D. Shutter, 2 B.T.A. 23. We have also held that expenditures made by a professional cartoonist for periodicals and other current literature and in attending political conventions, when properly proved, were proper deductions as ordinary and necessary business expense. J. N. Darling, 4 B.T.A. 449.

The Board is of the opinion from the facts in this proceeding that the petitioner is entitled to the deduction claimed.

Judgment will be entered on 15 days' notice, under Rule 50.

FOREIGN WORKERS AT THE U. S. FOREST PRODUCTS LABORATORY

THERE has assembled at the U. S. Forest Products Laboratory within recent months the largest group of foreign research men ever gathered at the federal laboratory at one time. Foresters and chemists from England, Australia, Sweden, Finland and Mexico have been detailed to the laboratory by their various governments and employers for periods ranging from thirty days to two years.

Mr. Wilhelm Rosen, a graduate of the Technological Institute of Stockholm, Sweden, and fellow of the Scandinavian-American Foundation, has just finished nine months of research on the distillation of softwoods in the Forest Products Laboratory's chemical utilization section. Mr. Eric Ostlin, also a fellow of the Scandinavian-American Foundation, will conclude observations of Forest Products Laboratory methods within a few weeks. In his native country, Mr. Ostlin, who is an expert on forest mensuration, has been directing a general forest survey which the Swedish government started ten years ago.

Messrs. J. E. Cummins and H. S. Dadswell are on detail from the Australian Council for Scientific and Industrial Research to engage in general forest products research at the Madison laboratory for a period of two years.

Mr. W. G. Campbell, who is a fellow of the Commonwealth (British) Foundation, has concluded a two years' stay at the laboratory, during which time he has been engaged in research on the fundamental chemistry of wood. He expects to accept an appointment with the Forest Products Laboratories of England on his return to that country.

Sr. Hermenegildo Barrios, a member of the first class to graduate from Mexico's new forestry school, has spent a year in studying the methods of various Forest Products Laboratory sections.

Mr. Uno W. Lehtinen, of the Finnish State Forest Service, has just concluded a month of study at the Forest Products Laboratory. Mr. Lehtinen, who is a graduate of the Yale Forest School, has spent three years in this country and is to return to Finland soon. He is expected to take an important position in the forest products research laboratory which his government is to organize.

SCIENTIFIC NOTES AND NEWS

PROFESSOR A. A. MICHELSON, of the University of Chicago, has been elected an honorary member of the Russian Academy of Sciences. Professor Albert Einstein (Berlin), Mme. Curie (Paris), Professor W. Nernst (Berlin) and Professor M. G. Mittag-Leffler (Djursholm, Sweden) have also been elected honorary members of the academy.

DR. L. W. AUSTIN, physicist of the radio research laboratory of the U. S. Bureau of Standards, has been awarded the 1927 medal of honor of the Institute of Radio Engineers. The medal carries the citation:

"Awarded to L. W. Austin for his pioneer work in the quantitative measurement and correlation of factors involved in radio wave transmission."

COLUMBIA UNIVERSITY has conferred the honorary degree of doctor of science on Brother Leon (Joseph Sylvester Sauget), professor of botany at Havana, Cuba, and Dr. Frank Baldwin Jewett, of the American Telephone and Telegraph Company.

AT the annual commencement of Jefferson Medical College on June 3, Dr. Fordyce Barker St. John, professor of surgery at the College of Physicians and Surgeons of Columbia University, and Dr. Francis X. Dercum, professor emeritus of nervous and mental diseases at Jefferson, received the honorary degree of doctor of science. Dr. St. John gave the commencement address.

DR. ARNO B. LUCKHARDT, professor of physiology in the University of Chicago, was recently honored at Washington when the Society of the Associated Anaesthetists of the United States and Canada presented him with a scroll recording his discovery of ethylene.

MRS. ZELIA NUTTALL has recently been elected fellow of the Royal Anthropological Institute of Great Britain and Ireland and corresponding member of the Geographical Society of Philadelphia, to fill the vacancy created by the death of Sir John Keltie, the president of the Royal Geographical Society of England.

WALLACE CLARK, member of the American Society of Mechanical Engineers, has received the commander's cross of the Order of Poland Restored for his services in connection with the reorganization of tobacco and salt monopolies of Poland.

DR. GENICHI KATO has been awarded the imperial prize of the Japanese Imperial Academy for his work on the conduction of the nerve impulse.

DR. A. C. D. CROMMELIN, astronomer at the Royal Observatory, Greenwich, has retired after thirty-six years' service.

DR. GEORGE E. BREWER, professor emeritus of surgery at Columbia University and head of a surgical division at Roosevelt Hospital, is retiring from his practice to devote his time to anthropological studies.

BANCROFT GHERARDI, vice-president and chief engineer of the American Telephone & Telegraph Company, New York City, was formally elected president of the American Institute of Electrical Engineers at the annual business meeting held in the Engineering Societies Building, New York, on May 20.

AT the annual meeting of the British Institute of Physics on May 16, the following officers were elected: *President,* Sir Frank Dyson; *vice-presidents,* Professor C. L. Fortescue, Sir Richard Gregory, Mr. R. W. Paul, Mr. R. S. Whipple; *honorary treasurer,* Major C. E. S. Phillips; *honorary secretary,* Professor A. O. Rankine.

J. S. DASH, professor of agriculture at the Imperial College of Tropical Agriculture, Trinidad, has accepted the post of director of agriculture and science in British Guiana.

DR. P. W. ZIMMERMAN, associate dean of the college of agriculture at the University of Maryland, has tendered his resignation to accept an appointment as plant physiologist of the Boyce Thompson Institute of Plant Research at Yonkers, N. Y.

DR. J. W. CHURCHMAN, professor of experimental therapeutics in the Cornell University Medical College, has been appointed delegate of the National Research Council to the International Union of Pure and Applied Chemistry which meets in Warsaw, Poland, in September.

DR. EUGENE C. BINGHAM, professor of chemistry at Lafayette College, will sail for Europe on July 2 as a delegate from the American Academy of Sciences and the National Research Council to the eighth congress of the International Union of Pure and Applied Chemistry to be held at Warsaw on September 5, 6 and 7. He will remain in Europe for the first semester for travel and study.

DR. A. ZIMMERMANN, associate physiologist of the Mayo Clinic, has sailed for a three months' trip to Europe. He gave a lecture in New York and will address different scientific meetings in Switzerland.

PROFESSOR F. HARDY, of the Imperial College of Tropical Agriculture, Trinidad, sailed for New York on June 7 to attend the First International Congress of Soil Science, to be held at Washington from June 13 to 22.

DEAN DAVID L. EDSALL has returned to the Harvard Medical School after six months' leave of absence. He has been at the Peking Union Medical College as visiting professor of medicine and making some general surveys of the school.

DEAN E. J. IDDINGS, of the college of agriculture at the University of Idaho, has been granted a leave of absence for six months. He left on May 17 on a round-the-world tour.

H. P. WHITNEY, Arctic explorer and naturalist, is to take a trip through northern Alaska, starting in

July, to get specimens of animals for the museum of Yale University.

THE second zoological expedition of the Brigham Young University, under the leadership of Dr. Vasco M. Tanner, will spend from June 4 to July 15 in southeastern Utah and contiguous states. Three weeks will be spent in making a biological study of the La Sal Mountains. The party will consist of Dr. Tanner, Dr. Cottam and five graduate students.

DR. J. M. ALDRICH, entomologist of the Smithsonian Institution, will collect Diptera through a half dozen states west of the Great Plains this summer.

LEONARD W. KEPHART, agronomist in the clover investigation office, U. S. Department of Agriculture, left on May 1 for a ten-months' collecting trip in British East Africa.

DR. TRUMAN MICHELSON, ethnologist in the U. S. Bureau of American Ethnology, recently left Washington to resume his studies among the Fox Indians of Iowa.

PROFESSOR HENRY H. DIXON, F.R.S., professor of plant biology at Trinity College, Dublin, is giving two courses at the University of California during the intersession and summer session.

PROFESSOR H. R. KRUYT, of the University of Utrecht, gave a lecture at Cornell University on May 9 on "Physico-chemical Research and Industry in Holland."

DR. LEONARD FREEMAN, professor of surgery in the University of Colorado Medical School, gave an illustrated lecture on "Prehistoric Surgery in the Western Hemisphere" before the Colorado chapter of Sigma Xi on the evening of May 27.

DR. COLIN G. FINK, Columbia University, addressed the New Haven chapter of the American Society for Steel Treating at the Waterbury meeting on May 12. Dr. Fink discussed the "Electrometallurgy of Chromium and its Alloys." On May 20, at Detroit, on the occasion of the founding of the Michigan chapter of the American Electrochemical Society, Dr. Fink lectured on "Recent Advances in Electrochemistry." On the evening of May 24 he addressed a group of artists and sculptors at the Machine Age Exposition on the "Restoration of Ancient Bronzes."

DR. A. F. BLAKESLEE, of the Station for Experimental Evolution, Carnegie Institution of Washington, delivered a lecture at the University of Texas on April 25 on "The Genetics of Datura."

DR. HENRY C. COWLES, professor of botany at the University of Chicago, gave two lectures at St. Lawrence University, Canton, N. Y., on May 17, under the auspices of the department of biology and the theological school. The lectures were entitled "Science and Culture" and "The Present Status of Evolution."

AT the regular spring meeting of the State College of Washington Sigma Xi Club an address on "Diagnosis of the Rots of Wood" was given by Dr. E. E. Hubert, of the school of forestry at the University of Idaho.

DR. EDWIN B. PAYSON, professor of botany at the University of Wyoming, died on May 15 at the age of thirty-four years.

DR. ABRAHAM ZINGHER, assistant director of the Bureau of Laboratories of New York and assistant professor of bacteriology at New York University, died on June 5 in his laboratory from poisoning due to the accidental leakage of gas.

DR. MAURICE F. FITZGERALD, emeritus professor of civil engineering in Queen's College, Belfast, died on May 4, aged seventy-six years.

DR. EDUARD BRUECKNER, professor of geography at the University of Vienna, died on May 21, aged sixty-four years.

A BRONZE bust of the late Alexander Smith, for many years professor of inorganic chemistry at the University of Chicago, has been recently presented to the university by Mrs. Smith. As the late Professor Nef was the founder of the department of chemistry and as Professor Stieglitz shared equally with Professor Smith in assisting Professor Nef in the upbuilding of the department, it has been decided that the university should also possess busts or paintings of Professors Nef and Stieglitz and a movement to provide funds for these has been started by a committee of graduates of the department. The busts or paintings of the three men will ultimately be placed in the library of the George Herbert Jones laboratory, the new research chemistry building about to be erected.

ACCORDING to press dispatches celebration of the centenary of the birth of Marcelin Berthelot, the great French chemist, recently took place at the Sorbonne in the presence of a distinguished group of scientific men. The Rothschild gift of 30,000,000 francs toward building the Institute of Chemistry will perpetuate Berthelot's memory. This building, to be known as the Maison de la Chimie, will become the headquarters of the International Chemical Union.

ACCORDING to the French correspondent of the *Journal* of the American Medical Association the hundredth anniversary of the birth of the French physiologist, Vulpian, was celebrated by appropriate ceremonies held at the Faculty of Medicine, of which

he was dean; at the seat of the Société de biologie, of which he served many years as the president, and at the Hôpital de la Salpêtrière, in which he had his service. The celebration was planned to cover a week (May 27–June 2). Foreign countries were invited to send delegates, and a number of unpublished scientific articles were presented on the occasion.

THE United States Veterans' Bureau Hospital at Knoxville, Iowa, is in need of a specialist in pathology. Applications for the examination for this position are now being received by the United States Civil Service Commission under its general announcement for medical officers (examination announcement No. 43). The entrance salary is $3,800 a year.

THE committee on scientific research of the American Medical Association invites applications for grants in aid of research on problems bearing on clinical medicine. Inquiries may be addressed to the committee at 535 North Dearborn Street, Chicago, Ill.

THE summer meeting of the American Mathematical Association will be held at the University of Wisconsin on Monday and Tuesday, on September 5 and 6, in conjunction with the summer meeting and colloquium of the American Mathematical Society. The society sessions will be on Thursday and Friday and the colloquium lectures on Tuesday to Saturday.

THE second National Symposium on Organic Chemistry will be held at Ohio State University, Columbus, O., from December 29 to 31, 1927. The headquarters will be at the Neil House. Suggestions for the program should be sent to the secretary of the division of organic chemistry of the American Chemical Society, Frank C. Whitmore, Northwestern University, Evanston, Illinois.

ON April 11, a meeting of chemists and physicists was held at Olivet College, Michigan, in honor of Dr. G. W. Stewart, of the State University of Iowa. Dr. Stewart read two papers—one general paper dealing with the quantum theory, and the other concerned with the results of his research in the field of X-ray liquid diffraction. There were about one hundred present.

THE first meeting of the Princeton chapter of the American Chemical Society was held at Princeton on June 3. Dr. Robert N. Pease, research associate of the American Petroleum Institute, who is carrying on his work in the Princeton University laboratories, was elected president. Professor Nathaniel Furman, of the Princeton chemistry department, was elected secretary, and Professor Charles P. Smyth, also of the department of chemistry, councilor.

THE twenty-eighth annual meeting of the American Röntgen Ray Society will be held at Montreal from September 20 to 23, under the presidency of Dr. A. Howard Pirie, of Montreal. This is the first occasion on which the society has met outside of the United States.

THE first International Congress on Mental Hygiene, aimed at a world-wide campaign for the prevention of nervous and mental disorders, will be held in Washington, D. C., in April, 1929, according to a decision reached on June 3 by representatives of thirteen nations meeting in Paris.

THE closing exercises of the school of tropical medicine of the University of Porto Rico, under the auspices of Columbia University, were held on the evening of May 11 in the assembly hall of the school at San Juan. There were addresses by Dr. Robert A. Lambert, the director; Dr. Thomas E. Benner, chancellor of the University of Porto Rico, and Dr. James W. Jobling, of Columbia University; Drs. Gutierrez Ortiz and Goyco, representing the medical profession of Porto Rico, and the Reverend Gonzales Palacios, of Valencia, Spain, and Dr. Frankel, of Boston, representing the student body. There were twenty-nine students in this the first year of the school of whom one, Dr. Gurbox Singh Sant, of Amritsar, India, received the "Certificate of Tropical Medicine."

THE fourth International Congress for Techno-Psychology will take place from October 10 to 14, 1927, in the apartments of the International Institute for Intellectual Cooperation at Paris.

DEDICATION ceremonies for the new $500,000 school of aeronautics at New York University were held on the campus at Washington Heights on June 4. Daniel Guggenheim made the formal presentation of the building to the university and Chancellor Elmer Ellsworth Brown made the acceptance speech. The principal address was made by William P. MacCracken, Jr., assistant secretary of commerce for aviation.

THE General Education Board has given $50,000 to Washington University School of Medicine, St. Louis, to assist in the work of the chest clinic under the directorship of Drs. Evarts A. Graham and Jacob J. Singer.

AT a recent meeting of the board of directors of the National Association of Audubon Societies, Dr. T. Gilbert Pearson, the president, announced the receipt of a gift of $156,000 from Mrs. Grace Rainey Rogers. The sum is to be held as an endowment fund for the maintenance of the Paul J. Rainey wild life sanc-

tuary in Louisiana, which she gave to the association in 1924.

APPROPRIATIONS to the amount of $1,316,542 for the Connecticut Agricultural College have been made by the General Assembly, included in which are funds for a classroom building, and for the increasing of the extension work of the college throughout the state. Funds appropriated for maintenance for the next two years include $475,000 for college and resident instruction; $160,000 for extension work throughout the state, and $70,000 for agricultural experiment station. In the aggregate these figures represent a gain of $45,000 over the amount appropriated at the last session of the legislature two years ago. Other appropriations include $420,000 for a classroom building; $28,000 for a pathological laboratory for the Storrs Experiment Station; $19,920 for equipping fruit storage building; $47,622 for enlarging filter beds of college water supply, and $96,000 towards enlarging work of county farm bureaus.

THE collection of books and periodicals on surgery of the late Dr. Albert E. Halstead has been donated by his widow to Northwestern University Medical School; they will be installed in a seminar room adjoining the Archibald Church Memorial Library and will be known as the "Albert Edward Halstead Surgical Library."

THE British Empire Marketing Board has granted funds to the Imperial College of Tropical Agriculture at St. Augustine, Trinidad, for the prosecution of banana research investigation destined to produce a new variety of banana immune from Panama disease. A quarantine station will be established at Kew, where root-stocks imported from other countries can be grown, and off-sets certified free from disease will be sent out to the Imperial College of Tropical Agriculture at Trinidad. This college will add to its staff plant physiologists and mycologists and all necessary laboratory equipment.

UNIVERSITY AND EDUCATIONAL NOTES

IT is announced that Yale University has already received $15,000,000 in its drive for a $20,000,000 endowment fund.

PRINCETON UNIVERSITY has received from Mr. Thomas D. Jones, a lawyer, and Miss Gwethalyn Jones, his niece, both of Chicago, $400,000 to found two professorships of research in the departments of physics and chemistry.

A DRIVE is to be conducted from June 6 to 14 for $1,500,000 for the erection of a new building for Jefferson Medical College on the north side of Walnut Street between the present college and Clifton Street.

DR. FERNANDUS PAYNE has been appointed dean of the graduate school of Indiana University and head of the department of zoology, in succession to the late Dr. C. H. Eigenmann.

PROFESSOR ARNOLD DRESDEN, of the University of Wisconsin, has been appointed professor of mathematics at Swarthmore College, Pa.

DR. S. W. RANSOM, of Washington University, has been appointed director of the Neurological Research Institute of the Northwestern University Medical School.

DR. J. W. CHURCHMAN has been appointed professor of experimental therapeutics in the Cornell University Medical College (New York) and director of the laboratory founded by outside gifts two years ago for the purpose of making it possible for him to continue his investigations of the bacteriostatic properties of the aniline dyes.

PROFESSOR BENJAMIN F. HOWELL, of Princeton University, has been elected to succeed the late Professor M. W. Twitchell as professor of geology and paleontology at the Wagner Free Institute of Science, Philadelphia.

AT Harvard University, Dr. Leigh Hoadley, assistant professor of biology at Brown University, has been appointed assistant professor of zoology, and Dr. Marshall Hertig, instructor of zoology in the University of Minnesota, assistant professor of medical entomology in the school of public health. Dr. Edwin C. Kemble has been promoted to be associate professor of physics, and Dr. Kirk Bryan, to be assistant professor of physiography.

DR. W. E. LOOMIS, of the horticulture department, University of Arkansas, will join the botanical staff of Iowa State College as associate professor of plant physiology beginning July 1.

DR. RUBERT S. ANDERSON has been appointed assistant professor at New York University in the department of physiology.

DR. D. MACC. BLAIR, lecturer in regional anatomy in the University of Glasgow, has been appointed to the chair of anatomy at the University of London, tenable at King's College.

DISCUSSION AND CORRESPONDENCE

CARELESSNESS IN NOMENCLATURE

KINDLY permit me to call the attention of editors, heads of zoological departments and others in similar

positions of authority to a regrettable carelessness and inaccuracy that beginners in physiological and experimental biological work tend to show, which should be corrected by those who are responsible for their training.

A simple case occurs in a recent paper issued by one of our leading research foundations which refers at the start to "the ovum of the spatangoid sea-urchin, *Clypeaster rosaceus*." Now this is much better than to have said merely "the ovum of Clypeaster," for the writer wished to be definite and let the reader know what kind of an animal he was talking about. But ought not the writer to have known that a clypeaster simply can not be a spatangoid? Is that too much to expect from a worker in the field of physiology?

A much worse case is that of a paper in one of our leading zoological journals which bears the amazing title: "The Effects of Ultraviolet Light on Pond Snails (Linnaeus)." Obviously this is an inexcusable blunder—Linnaeus never named a group "pond snails." Probably the word printed Linnaeus was written "Limnaeus" (= Lymnaea, a genus of fresh-water mollusks), but the writers, in reading the proof, failed to note the error. This blunder in the title might be regarded as a joke if it were not characteristic of the paper as a whole. The authors give no clue as to when or where their work was done. There is no hint as to whether more than one species of "pond snail" was used, but the statement is made that "snail embryos seem to be well adapted for this type of experimentation." Very likely—but "snails" and "pond snails" are two very different groups. When one considers that there are hundreds of species of pond snails in the United States (assuming that this piece of work was done in this country—for which assumption there is no evidence), belonging to many genera and several families, is it not absurd to make statements about the effects of ultraviolet light on pond snails and not specify the forms used? Granting that the writers intended to limit their "pond snails" to the genus Lymnaea, as is quite possible, the situation is not much better, for the genus Lymnaea, in its old, wide sense, includes hundreds of species showing a great range of characters. Now, *some one ought to have required these writers first of all to know what animal or animals they were working with.* Without such knowledge, clearly stated at the start, work of this kind has little if any value.

A third case has just come to hand. Here is a paper entitled "A Study of the Genetic Relationships of the 'Amebocytes with Spherules' in Arbacia." The lay reader will naturally want to know what Arbacia is. He gets a hint that it is an echinoid, from references to other publications, but there is no definite statement on the point nor is there any clue as to where or when the observations recorded were made. We are told that the perivisceral fluid of *Arbacia punctatum* was used; this seems definite until we discover that there is no such species of Arbacia known as *punctatum*. There are half a dozen species of Arbacia recognized and twenty or more names have been given to them—but there is no *punctatum*. However, Lamarck did give the name *punctulatum* to a species which is found at Woods Hole, Mass., so that most readers will guess that this piece of work was done at Woods Hole and that *Arbacia punctulata* was used. But is there really any excuse for publishing the name as *punctatum*? Is it unfair to think that so doing indicates carelessness, or indifference to accuracy or both? In my opinion the paper should have had the title: "A Study of the 'Amebocytes with Spherules' in a Sea-Urchin." In the first paragraph should have been a statement to the effect that the work was based on material of the sea-urchin, *Arbacia punctulata* (Lam'k.), obtained at Woods Hole, Mass., in the summer of 1925 (or whenever it may have been). Such a statement forms a definite foundation on which the work may rest; without it every statement made is open to doubt.

HUBERT LYMAN CLARK

CAMBRIDGE, MASS.

SOME NEW LECTURE DEMONSTRATIONS IN GYROSCOPIC MOTION

IF an ordinary gyroscopic top is equipped with hooks at each end of the axis in the form of wire loops, the top when rotating will walk down an incline made of two rods (Fig. 1).

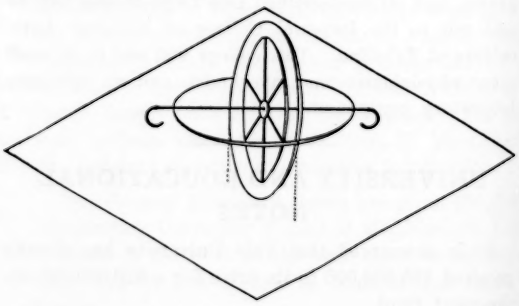

FIG. 1. This top will walk down two parallel inclined rods which pass through the hooks.

The top starts to slide down the wires, but friction retards one end more than the other—this causes the top to precess, the free end rises and moves forward. After this end has moved forward it strikes the rod on

which it hangs, stopping its precession so that this end falls. Then the other end precesses and so on alternately with a motion that simulates walking or going hand over hand down the two rods.

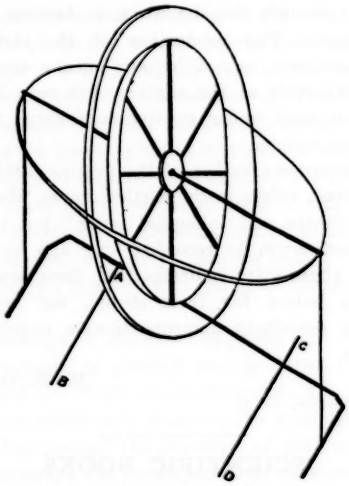

FIG. 2. This top when rotating will walk down an inclined plane. There must be two wires parallel to the board shown by AB and CD.

If the top is provided with feet it will waddle down an inclined plane. It is necessary, however, to have two wires (AB and CD of Fig. 2) at a height of an inch or so above the inclined plane and parallel to it. The wires stop and start the precession.

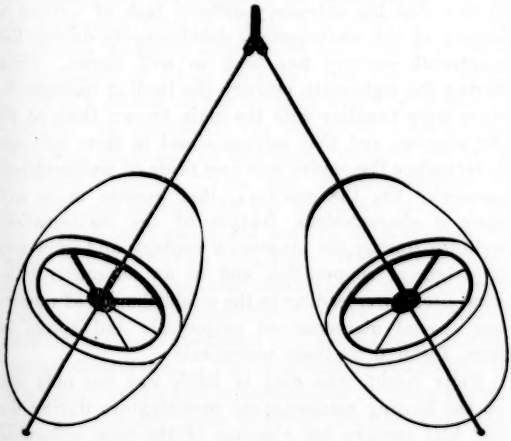

FIG. 3. A double top to show precession.

Two gyroscopic tops hinged to the end of a metal rod form a useful device for illustrating the action of precession. If both tops are spinning in the same sense, they will rise when the rod is spun clockwise (say) and fall when the rod is spun in an anti-clockwise rotation. If, however, the tops are spinning in opposite directions and the rod rotated, one top rises while the other falls.

ROBERT C. COLWELL
WEST VIRGINIA UNIVERSITY

THE PRECIPITIN REACTION AS A MEANS OF DETERMINING THE CONGENIALITY OF GRAFTS

RIVES[1] has suggested the possibility of using serodiagnostic methods for predicting the "affinity" between stock and scion in the grape. He reports success with this method for a number of common grape stocks. Green[2] found that by using extracts of seeds differences between families could be demonstrated, but not differences between species of the same genus. With this in mind, a test involving two plums, Beauty and Santa Rosa (*Prunus salicina*), and the almond (*Prunus communis*) was carried out. The former plum makes an unsuccessful union with the almond, while the latter makes a good union. Since the vegetative portion of the plant is the part involved in grafting, we followed Rives in using one-year-old shoots as a source of material, but followed Green's procedure for the most part.

Sap was extracted by pressure of about 6,000 pounds per square inch, a special press made from a concrete tester being used. After filtration the extract was injected, at first in the dilution of 2 to 1, later without dilution. Three pairs of rabbits were used, one for each extract. The schedule called for injection at four-day intervals for a period of six weeks. A total of 80 cc extract (on the basis of undiluted sap) was injected into each rabbit. None of the six showed any infection or other disorder save loss in weight toward the close of the experiment. Each extract was tested with each immune serum at the end of the period and with normal serum at the beginning and the end of the experiment.

It was found that although a distinct reaction was obtained, showing a precipitate in dilution of 1 to 1,600, there was no differentiation between them. This confirms Green's data on the lack of differentiation in closely related species, but does not confirm the conclusion that the method can be used to predict affinity. Green has apparently overlooked the fact that many varieties of the genus Prunus can not be intergrafted, and that the apple and pear (which give an indication of affinity by the precipitin test) rarely make successful unions. It seems to the authors that the uniformity of the reaction in reciprocal tests and in the comparative tests indicates that more

[1] Rives, L., "Sur l'emploi du sero-diagnostic pour la determination de l' 'affinite' au greffage des hybrides de vigne." Prog. Agr. et Vit., 79: 118–119. 1923.

[2] Green, F., "The Precipitin Reaction in Relation to Grafting." *Genetics*, 11 (1): 73–82. 1926.

refinements in procedure must be developed before these slight differences can be demonstrated.

E. L. PROEBSTING
E. H. BARGER

UNIVERSITY OF CALIFORNIA

IN RE "SINGING EARTHWORMS"

SINCE the publication in 1926 of a popular article entitled "When Earthworms sing Together,"[1] quoting Dr. Mangold, of Freiburg, Germany, and which has been previously referred to in these columns,[2] considerable publicity has been given the subject by the American press.

For "lo these many days," it has been the writer's custom to keep captive, in numbers as large as one hundred or more, adult specimens of the large cosmopolitan earthworm, *Lumbricus terrestris* Linn. They are kept in a five-gallon earthenware crock in a cool corner of the cellar for use in a pursuit which in some states of the Union is considered immoral or at least illegal when indulged in on Sunday. In the course of my dealings with these worms I have many times heard the sounds recently referred to as "singing" and, although personally fond of music, have failed to notice anything in the least musical about these faint clicking sounds or stridulations, recently termed "song." The singing of insects, for instance, could be considered as symphonic poems when compared with these insignificant rustlings. Previous to the publication of the recent somewhat sensational statements, little attention was paid to them as it had seemed to me that these sounds were probably produced by the movements of the worms in their burrows, possibly by the escape of air between the viscid lining of the burrow and the mucous surface of the worm's body. It is quite evident, however, that this is not the case, because these stridulations have continued after the worms were transferred from the soil to damp sphagnum moss, which is an ideal medium in preparing the worms for the rites to which I have previously alluded. The determination of the manner in which earthworms produce these mysterious sounds is fraught with difficulty because the species with which I have dealt at least is very sensitive to the presence of light intense enough to permit one clearly to observe its actions and movements, when on the surface of the soil. That this sense of light resides in the extreme anterior end of the body is abundantly evident from the fact that the worms instantly withdraw to their burrows when the light from an electric torch is flashed upon them even when but a half inch or less of the "head" end of the body protrudes from the soil. In point of fact, the worms seem most sensitive to the light when this is the case. When the entire body is exposed it often requires as much as fifteen or twenty seconds for the worm to become alarmed at the light. The production of the stridulating sounds, however, is not by any means confined to those individuals at the surface, but may be heard plainly, at least under captive conditions, when no worms are visible.

The anonymous author of the original article, previously cited, refers to the earthworm as "dumb both in a legitimate and colloquial sense," but the story of the earthworm as recorded long ago by Charles Darwin[3] abundantly indicates that these lowly creatures are indeed far from stupid, but apparently possess a seemingly disproportionate degree of intelligence.

W. R. WALTON

WASHINGTON, D. C.

[1] *Literary Digest*, October 9, 1926.

[2] Ruedemann, Rudolph, SCIENCE, February 11, 1927, p. 163.

[3] "Formation of Vegetable Mould through the Action of Earthworms," London, 1881; D. Appleton and Co., New York, 1882.

SCIENTIFIC BOOKS

Vorlesungen über die Entwicklung der Mathematik im 19. Jahrhundert, Teil 1. By FELIX KLEIN. Verlag von Julius Springer, Berlin, 1926, pp. XIII + 385.

NEVER before was the mathematical literature enriched by a general historical work written by such an eminent mathematician, and those who are especially interested in the history of science will be glad to find that the extremely difficult task of writing a history of the mathematical developments during the nineteenth century has been so well begun. Even during the eighteenth century the leading mathematicians were familiar with the main known facts of all the sciences, and they seldom aimed in their writings to introduce the reader into new fields of mathematical research. On the contrary, this became more and more a characteristic feature of the mathematical writings during the nineteenth century and gave rise to extensive cooperation and to an enormous technical literature, leading to the establishment of numerous special mathematical periodicals and being, in turn, fostered by these periodicals.

Felix Klein, who died in 1925, was not only one of the leading mathematical investigators during the last half century but also one of the most influential mathematical organizers. He worked with extraordinary success in various fields of mathematics, including mathematical physics as well as the teaching and history of our subject. A number of leading Amer-

ican mathematicians were among his students and later helped to develop in our country a deep and abiding interest in mathematical research. The lectures which constitute the present volume were given at his home to a small number of students during a period of about five years, and he had expected to revise them and then publish them as his last mathematical contribution. On account of illness he could not do this and therefore the present volume was prepared for the press by those who were entrusted with his unpublished papers. Fortunately the editors decided to make no important changes so that we have here the words of a mathematical statesman which should interest not only mathematicians but also others who are interested in the great cultural forces of our age.

The headings of the eight chapters into which the present volume is divided are as follows: Gauss; France and the École Polytechnique in the first decades of the nineteenth century; the establishment of Crelle's Journal and the blooming of pure mathematics in Germany; the development of algebraic geometry beyond Moebius, Plücker and Steiner; mechanics and mathematical physics in Germany and England until about 1880; the general theory of functions of complex variables by Riemann and Weierstrass; deeper insight into the essence of algebraic forms; group theory and function theory, especially automorphic functions.

These headings represent fundamental centers in the remarkable development of mathematics during the nineteenth century. They also point to the fact that Klein naturally emphasized the history of those developments in which he either took part or which are closely related to the subjects which he helped to advance. In particular, the theory of numbers, algebra and the theory of aggregates received relatively too little attention. This lack of completeness is, however, compensated by the confidence inspired by one who speaks about the history of a subject on which he himself is an authority. While some attention is paid to biographical sketches and other matters which are not strictly mathematical we find here also some of the most profound and far-reaching mathematical observations. The commanding but attractive personality of the author is exhibited in many places, and his unusually wide personal acquaintance with leading mathematicians and with their most important contributions adds greatly to the value of the work. As an instance of the type of some personal remarks we may note that in speaking about H. Poincaré it is noted on page 375 that he did not enter the field of applied mathematics in the proper sense of this term and hence his contributions may be regarded as somewhat below those of Archimedes, Newton and Gauss, who also experimented and measured.

G. A. MILLER

UNIVERSITY OF ILLINOIS

SCIENTIFIC APPARATUS AND LABORATORY METHODS

SYNTHETIC RESIN AS A MOUNTING MEDIUM

IN the issue of SCIENCE for January 14, 1927, announcement was made of a new synthetic resin possessing physical and optical properties which made it particularly useful in microscopy. Having had experience with other compounds which at first seemed promising, yet later spoiled for one reason or another, the only doubt I had or expressed at the time the above-mentioned article was prepared concerned the stability of the product. It was first made on October 6, 1926, and a part of the original sample, as well as slides mounted therefrom, is in perfect condition on April 1, 1927. Evidently, the resin can be depended upon to keep unchanged for a period of many months; we have no reason to suspect that it will ever change.

In fluid form, this material has a refractive index of close to 1.70 for yellow light, and when hardened on the slide, it approaches 1.80, the exact figure not yet having been determined because it is far above the scale of any available refractometer.

A great deal of interest in this material has been shown by microscopists in many parts of the world as a result of the preliminary announcement in SCIENCE, and if the inquiries I have received can be used as a basis for forming an opinion, it certainly appears that there is a real desire in many branches for a better material than Canada balsam for a mounting medium.

For the benefit of all interested workers, I want to explain that I have developed the technique of handling the resin, only in the mounting of diatoms. It is so superior to other known resins for this purpose that one is tempted to call it ideal.

Whether methods of using it in other branches of microscopy can be developed or not remains to be determined by experiment. Thus far the best solvent we have found is aniline, but this does not necessarily mean that the last stage before mounting a preparation should consist of clearing in the solvent. Aniline is not very volatile; consequently a more protracted or higher temperature is needed to bring the resin to brittle hardness under the cover than would be the case could xylol or benzol be used as solvent. The hardened slides do not show a tendency to lose their

covers by chipping. Improvement in methods of manufacture are expected to produce a material with a greatly reduced yellow color, but it is not likely to ever be water-white. The experienced microscopist will readily detect the ease with which transmission of the green ray for which most objectives are corrected is effected.

Upon heating, the material becomes so fluid it readily passes through filter papers and this property makes it very superior in diatom-work because of the freedom of the slides of bubbles. Its high index of refraction is its most valuable property, of course, and it should make chitinous structures, such as insects, crustaceans, etc., readily visible without staining.

Experiments are still in progress by the chemists, L. A. Penn and Paul Ruedrich, of Berkeley, California, in order to determine the best method of preparation of the resin and the chemical reactions involved.

G. DALLAS HANNA

CALIFORNIA ACADEMY OF SCIENCES,
SAN FRANCISCO, CALIF.

A NEW USE FOR THE NEPHELOMETER AND REFRACTOMETER

DURING the course of certain experiments with a large number of samples of sweet corn, it became essential to determine with a minimum of time and effort the relation between vigor and the condition of the distilled water in which it had been soaked. Some years ago, when the question of the toxicity of distilled water was under discussion, evidence was presented that the injurious effect produced on seedlings grown in distilled water was at least partially due to the extraction of electrolytes from the roots. These determinations were made in several instances by means of conductivity measurements. Apparently none of the investigators attempted to measure the effect of distilled water on dormant seeds. A number of experiments were undertaken along this line, but the Abbé refractometer was used instead of the hydrogen-ion concentration as the means of determining the relative quantities of solids leached from the seeds. The method is extremely simple, consisting merely of soaking 5 or 10 gm of seed in 50 cc of distilled water in well-stoppered bottles for forty-eight to seventy-two hours at a temperature of 30° C. Two or three drops of the liquid are all that is required for the reading. In order to check the test thousands of readings were taken of distilled water in which sweet corn seed had been immersed. In nearly all cases duplicate samples from the same ear were planted on the greenhouse bench and the growth of the seedlings compared with the instrument readings. A representative portion of one of the experiments is given in the accompanying table. This will give an idea of the responsiveness of the test. The refractive index tends to increase in inverse proportion to the vigor of the seedlings. When the refractive indices (x) are correlated with the seedling characters (y) of the entire series of 116 ears in this particular experiment, $r_{xy} = .592 \pm .041$ when y = per cent. germination; $r_{xy} = .360 \pm .055$, when y = height of seedling; and $r_{xy} = .343 \pm .055$ when y = green weight. Higher correlations have been obtained in other series.

No.	Refractive index (21° C.)	Colloidal index (mm) (Std. 30 mm)	Greenhouse test: Pet. germination	Greenhouse test: Increases over check: height (mm)	Greenhouse test: Increases over check: greenweight (gm)
28	1.33595	1.05	0	− 93.0	− 0.26
29	1.33470	3.05	0	− 93.0	− 0.26
30	1.33440	6.90	15	− 82.5	− 0.23
31	1.33455	3.55	0	− 93.0	− 0.26
32	1.33445	7.05	45	− 23.5	− 0.06
33	1.33420	7.25	65	− 18.0	− 0.07
34	1.33540	4.00	0	− 134.4	− 0.30
35	1.33510	1.95	0	− 134.4	− 0.30
36	1.33440	3.85	30	− 44.5	− 0.10
82	1.33410	20.25	95	5.6	− 0.08
83	1.33400	25.20	100	116.6	0.38
84	1.33410	30.95	100	112.0	0.42
85	1.33405	26.15	100	73.2	0.21
86	1.33415	17.45	90	50.4	0.16

Early in the experiments it became apparent that high refractive indices were accompanied by the presence of dense suspensions of colloids. Upon reading these with a Leitz nephelometer it was at once apparent that in many respects the colloidal index of the leachings is superior to the refractive index as a measure of the potential vigor in sweet corn. The colloidal indices in the above table are typical. The standard used in these experiments consisted of 0.5 per cent. c.p. soluble starch dissolved in 0.5 per cent. sodium toluene para sulphochloramid.

It should be noted that the coefficients of correlation for the entire series are even higher than for the refractive indices. The values are $r_{xy} = .634 \pm .037$ when y = per cent. germination; $r_{xy} = .680 \pm .034$ when y = height of seedlings; and $r_{xy} = .693 \pm .033$ when y = green weight. The correlation between the refractive and colloidal indices is $r_{xy} = .713 \pm .015$.

A considerable tendency exists for the coefficients of correlation to increase inversely as the percentage of germination in the case of the colloidal index. This is illustrated by the following:

Mean pct. germination	Correlation between colloidal index and (1) pct. germination	(2) height	(3) green weight
55.8	.634 ± .037	.680 ± .034	.693 ± 0.33
76.5	.498 ± .051	.534 ± .049	.547 ± 0.48
86.5	.374 ± .026	.341 ± .027	.313 ± .027

According to this the colloidal index test is increasingly accurate as the sweet corn becomes more inferior. This is a very decided advantage.

A number of students in the laboratory of plant physiology at the University of Illinois have used the nephelometer with decided success in measuring the reduction of vitality as affected by disease or following treatment with various chemical and physical agents. It is possible that these tests may prove useful in determining viability in grains and in other seeds having a fairly large endosperm.

CHARLES F. HOTTES
WALTER A. HUELSEN

UNIVERSITY OF ILLINOIS

SPECIAL ARTICLES

EXCYSTATION IN VITRO OF HUMAN INTESTINAL PROTOZOA[1]

FOR many years it was believed that the cysts of intestinal protozoa would not excyst until subjected to the digestive juices peculiar to the normal host of the species. Recent experimental work, however, indicates that moisture and a temperature of about 37° C. for several hours are the only factors necessary to stimulate excystation in the intestinal protozoa of man. Darling[2] (1913) noted the disappearance of cysts and the appearance of trophozoites in feces containing cysts of *Endamoeba histolytica* that were kept in a moist chamber. It is not at all certain, however, that the trophozoites observed came from the cysts, since amoebae of other species often appear in fecal material kept under similar conditions. Yorke and Adams[3] (1926) observed the process of excystation in this species; Allen[4] (1926) describes what she believes to have been excystation in the form named by Kofoid and Swezy[5] (1921) *Councilmania lafleuri*; and Smith[6] (1927) has observed, and shown to the writer, excystation in *Iodamoeba williamsi*. The writer[7] is now able to add to this list *Endamoeba coli, Endolimax nana* and the flagellate *Chilomastix mesnili*; he has also observed early stages of what appears to be excystation in vitro in *Giardia lamblia*. The other intestinal protozoa of man are *Trichomonas hominis* and *Endamoeba gingivalis*, which have no cyst stage, and *Embadomonas intestinalis, Tricercomonas intestinalis* and *Dientamoeba fragilis*, which are rare species not easily obtained for study.

Endamoeba histolytica. Excystation in vitro in this species has been described by Yorke and Adams (1926). Material containing cysts was sealed under a cover glass and examined in a warm microscope chamber. Pseudopodia were formed inside of the cyst; then a break appeared in the cyst wall through which the amoeba escaped. Moisture and a temperature of about 37° C. seemed to be the essential factors in excystation. Cysts that had been in Locke-egg-serum medium at 37° C. for two hours proved more satisfactory than unincubated specimens.

Councilmania lafleuri. Allen (1926) saw what she believed to be the last of eight amoebulae to escape from the cyst wall of this species. According to her observations the entire amoeba does not leave the cyst, but the eight amoebulae into which it divides pass out one by one through a pore in the cyst wall.

Iodamoeba williamsi. Excystation in this species has been observed by Septima C. Smith (1927). She found that cysts fifteen hours old, when placed in an incubator at 37° C. for two hours and then in a warm chamber at about 40° C. for three hours, would excyst in a saline medium. Minute pseudopodia were noted within the cyst; then followed a break in the wall and the escape of the amoeba. In some cases the amoeba emerged part way and then returned, escaping only after several passages back and forth. The newly excysted organisms were very active. She concluded that the stimuli necessary for excystation are moisture and a temperature of about 37° C. for several hours.

[1] From the Laboratory of Protozoology, Johns Hopkins School of Hygiene and Public Health. The writer is greatly indebted to Mr. Conrad Bauer for his valuable assistance.

[2] Darling, S. T., 1913. "Observations on the cyst of *Entamoeba tetragena.*" Archiv. Int. Med., 11: 1–14.

[3] Yorke, W. and Adams, A., 1926. "Observations on *Entamoeba histolytica.* I. Development of cysts, excystation and development of excysted amoebae, in vitro." Ann. Trop. Med. and Parasit., 20: 279–302.

[4] Allen, E. A., 1926. "Excystment of *Councilmania lafleuri* Kofoid and Swezy in culture in vitro." Univ. Cal. Pub. Zool., 29: 175–178.

[5] Kofoid, C. A. and Swezy, O., 1921. "On the free, encysted and budding stages of *Councilmania lafleuri*, a parasitic amoeba of the human intestine." Univ. Cal. Pub. Zool., 20: 169–198.

[6] Smith, Septima C., 1927. "Excystation in *Iodamoeba williamsi* in vivo and in vitro." SCIENCE, 65: 69–70.

[7] Hegner, Robert, 1927. "Excystation and infection in the rat with *Giardia lamblia* from man." *Amer. Journ. Hyg.* (in press).

Endamoeba coli. Excystation of *E. coli* was observed many times by the writer in material obtained by washing infected feces in water. This material either in water or in weak saline solution was sealed under a cover glass and placed on the stage of a microscope confined in a warm chamber. The protoplasm within the cyst is at first finely granular and the eight nuclei are usually clearly visible, but later the nuclei become invisible and a number of larger granules of various sizes appear. The first evidence of activity preceding excystation is the movement of the cytoplasm in the center of the cyst. No large free area exists between the cyst contents and the cyst wall such as described by Smith (1927) in *Iodamoeba williamsi.* Pseudopodia first appear through an opening in the cyst wall. This opening is small and the protoplasm streams through it rapidly in a thin strand. The amoeba does not leave the cyst wall at once, but usually, after from one half to three fourths of the protoplasm has escaped, movement begins in the opposite direction and most or all of the animal streams back again into the cyst. This egress and return of the protoplasm may occur as often as ten times before complete escape is effected and the liberated amoeba moves away from the deserted cyst wall.

After excystation the amoeba moves at first slowly but soon flows across the field by means of rapidly forming pseudopodia. These pseudopodia are somewhat similar to those of *E. histolytica,* being formed rapidly and more or less explosively and being at first free from granules although not so clear and hyaline as those of *E. histolytica.* In every case the entire contents of the cyst emerged as a single amoeba. Excysted amoebae were watched for more than six hours, but no division stages were observed.

Endolimax nana. Excystation could not be studied as easily in *Endolimax nana* as in *Endamoeba coli* because of its minute size. So far as could be observed, however, the process was similar in every respect. The first evidence of activity was movement in the cytoplasm; this was followed by a minute break in the cyst wall through which the cytoplasm protruded; then after flowing in and out several times the organism separated from the cyst wall as a single amoeba.

Chilomastix mesnili. Excystation of this flagellate was seen in only one case. The details were not clearly made out, but the essential features were observed. Movement of the protoplasm within the cyst was followed by a break in the wall at the anterior end and the rapid emergence of the organism, which soon took on approximately the shape of a typical trophozoite. One large cystostome was present. Whether the excysted specimen contained one or two nuclei was not determined. In this case the cyst was in a saline medium and excystation occurred after three hours and forty minutes at about 37° C.

Giardia lamblia. Complete excystation of *Giardia lamblia* in vitro has not been observed, but movement within the cyst can be brought about by the same method as that shown to be effective with other protozoa. Washed cysts from two to four days old were used. Material was sealed under a cover glass and kept in an incubator at 37° C. for two hours; it was then placed on the stage of a microscope in a warm chamber at approximately 39° C. Within from ten to fifteen minutes movement began in some of the cysts. The contents seemed to contract and expand, due probably to bending movements of the axostyle such as were observed in cysts recovered from the small intestine of the rat (Hegner, 1927). The protoplasm of the organism was seen to shrink away from the cyst wall and after from one to four hours became quiescent.

It seems safe to conclude from these observations that, as suggested above, moisture and a favorable temperature (about 37° C.) for a sufficient period (several hours) are the essential factors in excystation. It, therefore, follows that the digestive juices of the host that ingests the cysts of intestinal protozoa are unnecessary in bringing about excystation. They may be helpful, but on the other hand it is possible that they are harmful. If the latter is true, then the cyst wall probably protects the cysts from the secretions encountered in the stomach. In this connection it may be noted that no excystation nor protoplasmic movements were observed within the cysts of *Giardia lamblia* that were injected into the stomach of the rat, although cysts hatched in the small intestine of this animal (Hegner, 1927). Further details of excystation in these intestinal protozoa will be published in a later communication.

ROBERT HEGNER

THE JOHNS HOPKINS SCHOOL
OF HYGIENE AND PUBLIC HEALTH

ISOTOPES OF CALCIUM

THE writer has recently studied the selective reflection of several carbonates at about 6.5 microns. Polarized light was used so that bands due to vibrations along the different directions in the crystal would not be superimposed. In the case of calcite ($CaCO_3$) three small maxima were observed. The wave lengths were 6.36 μ, 6.54 μ, and 6.62 μ. When several bands overlap, it is difficult to calculate the true intensity of the separate bands as there is no zero line of reference. However, using the band at 6.54 μ as the standard, the band at 6.36 μ is about

one twentieth as intense; also, the band at 6.62 μ is about one fifth as intense as the band at 6.54 μ. So it is likely that calcium is made up of isotopes with atomic weights of 39, 40 and 44 and of quantities in the ratio of one fifth, one, one twentieth, respectively. The atomic weights given would have the approximate separation as found for the bands and these atomic weights with the quantities named would give a mean atomic weight about 40.

It is interesting to note that calcium has been studied for isotopes by Dempster,[1] Aston[2] and G. P. Thomson.[3] Dempster found points which correspond to 40 and 44 and another set of points which correspond to atomic weight 39. However, he considered the 39 as due to potassium, which likely occurred as an impurity. Aston also studied calcium, but due to the fact that it did not produce anode rays easily, he did not find a line for calcium of atomic weight 44. Aston carefully excluded potassium from the mixture, but the line corresponding to atomic weight 39 was more intense than the 40 line. So the line at 39 was possibly a mixture of potassium and calcium. G. P. Thomson's work on calcium gives a broad line at 40 which was not resolved by his instrument. However, he states that there must be another line at 39 or 41 making calcium an isobar with potassium. So it is likely that calcium has an isotope of atomic weight 39. In addition to the above facts it appears that it would have been very difficult to detect the isotope of atomic weight 44 if the intensity were only one seventieth of that of atomic weight 40. It could not have been observed by the method of band spectra used by the writer. It seems probable, therefore, that the isotope Ca^{44} is present to a greater extent than one seventieth and that a mean atomic weight of 40.07 is made possible by the presence of Ca^{39}.

E. K. PLYLER

UNIVERSITY OF NORTH CAROLINA

A PRE-CHATTANOOGA SINK HOLE[1]

THE Chattanooga shale is locally five to seven times the thickness generally observed in the region of the Gainesboro, Tennessee, quadrangle. This fifteen-minute quadrangle, ten miles south of the Tennessee-Kentucky line, was mapped by the Topographical Branch of the United States Geological Survey in 1925. Through it the Cumberland River swings in entrenched meanders four hundred feet below the level of the dissected Highland Rim Plateau.[2] The Fort Payne formation of lower Mississippian age is at the surface of the plateau throughout the area. Beneath the Fort Payne a green shale, varying in thickness from a few inches to one or two score feet, lies upon the Chattanooga shale. The Leipers, Catheys and Cannon strata of Ordovician age, together four hundred feet thick, are separated from the Chattanooga shale by a disconformity. The rocks of the region are gently arched in a northeastern extension of the Nashville Dome.

The writer spent three and a half months of the 1926 field season mapping the areal geology and structure of the Gainesboro quadrangle for the State Geological Survey of Tennessee. An interesting result of the summer's work was the discovery of an extraordinary local thickness of the Chattanooga shale. This body of shale is generally ten to fifty feet thick in the Nashville Basin and adjacent areas. According to general observation, the thickness does not vary more than five or ten feet in many miles.[3] The writer found the thickness to exceed 149 feet on Flynn Creek, five miles south of Gainesboro. The shale is exposed in several places in the vicinity with seventy-five or ninety feet of strata visible in a continuous outcrop. It lies in an irregular closed depression or series of depressions in a limestone conglomerate-breccia which is at the same altitude as Leipers, Catheys and Cannon strata. The actual contact of the breccia with formations other than the shale was not seen. Some of the blocks in the breccia contain fossils common to the Leipers and Catheys, but the fossils do not determine with certainty the formations from which the blocks were derived. Some of the blocks differ in lithology from the pre-Chattanooga strata heretofore observed in this general area. It is possible that a detailed and thorough study of all the blocks might yield information which would partially close the hiatus between the Leipers and Chattanooga deposits. The breccia is more than one hundred feet thick in some places.

[1] *Physical Rev.*, 18, 421, 1921.

[2] Aston, "Isotopes," p. 101.

[3] *Phil. Mag.*, 42, 857, 1921.

[1] Printed with the permission of the state geologist of Tennessee.

[2] Purdue, A. H., "General Oil and Gas Conditions of the Highland Rim Area in Tennessee," Resources of Tenn., Vol. 7, No. 4, pp. 220–228. 1917.

[3] Butts, Chas., "Geology and Oil Possibilities of the Northern Part of Overton County, Tennessee, and of Adjoining Parts of Clay, Pickett and Fentress Counties," Tenn. State Geol. Survey Bull., 24, pt. 2-A. 1919. Hayes, C. Willard, and Ulrich, O., U. S. Geol. Survey Geol. Atlas, Columbia folio (No. 95). 1903. Mather, Kirtley F., "Oil and Gas Resources of the Northeastern Part of Sumner County, Tennessee," Tenn. State Geol. Surv. Bull. 24, pt. 2-B. 1920. Miser, Hugh D., "Mineral Resources of the Waynesboro Quadrangle, Tennessee," Tenn. State Geol. Survey Bull. 26. 1921.

The extent of the increased thickness of the Chattanooga shale and the presence of the conglomerate-breccia coincide in an irregular area about two miles in diameter with outcrops visible in the valley of Flynn Creek and its tributaries, Rush Fork, Cub Hollow, Lacey Hollow and Steam Mill Hollow, where they join that stream. Outside this area the Chattanooga shale is about twenty feet thick and rests disconformably upon the Leipers limestone. Gentle dips obtain throughout all but this part of the Gainesboro quadrangle. Here the Ordovician limestone strata dip at 15°, 20°, and even higher angles. On the south, east and north the dips for short distances are toward the area. On the west there may be surficial faulting of the Ordovician. The top of the shale is at a lower altitude where it rests upon the brecciated limestone than at adjacent outcrops, in general being lowest where the shale is thickest. This difference in the altitude of the top of the shale amounts to more than one hundred feet as determined by stadia and telescopic alidade. Where the shale is nearest its normal altitude, it is thin and lies upon hills of the conglomerate-breccia.

Several hypotheses were considered at the time the writer was investigating and mapping this peculiar feature. The figure obtained for the thickness was questioned, for in landslides strata that are high on the sides of a valley may slump to the bottom of the valley with their attitude practically unchanged. But the shale is completely exposed in sections up to ninety feet thick in single outcrops, and it crops out practically continuously in the bed of Flynn Creek and tributaries with the same system of joints throughout.

The question arose as to the possibility of post-Chattanooga diastrophism restricted to this small area. There might have been subsidence, or perhaps uplift followed by subsidence which deformed the shale so that at this one place it is exposed in the bed of Flynn Creek, whereas, both upstream and downstream from this locality, its base is high on the sides of the valley. The diastrophism might have proceeded in such a way as to produce the brecciation and high dips in the limestone. Bucher has described a circular area of intense folding and faulting in Adams County, Ohio, and refers it to the class of "crypto-volcanic" structures.[4] However, the thickness of the shale and the absence of folding or brecciation of the shale and overlying beds, which are structurally conformable, indicate that the Chattanooga shale and later formations could not have been affected by such diastrophism. Moreover, the actual exposure of the contact of the shale and breccia shows an irregular erosion surface which is not paralleled by the contact of the Chattanooga shale with the overlying green shale at the base of the Fort Payne chert. The conglomeratic nature of the breccia and the absence of veins or dikes of possible igneous origin discourage the view that sub-surface vulcanism may have been the cause of the diastrophism, either before or after Chattanooga time.

From the observed facts noted above, it is clear that at the inception of the deposition of the Chattanooga shale there must have been a depression with an irregular outline and an uneven floor. In the bottom of the depression and along the walls there were considerable thicknesses of slightly rounded fragments of limestone derived in part from the Ordovician limestones still represented in the surrounding area. Possibly there were also fragments from still higher strata, now eroded and entirely removed except at this one place where they are thus represented.

A depression of this sort could be formed by the collapse of the roof of an irregular branching cavern or series of caverns. The fragmentation induced by collapse, together with the slope wash of talus towards the lines of collapse, would form the conglomerate-breccia.

The Chattanooga shale was deposited in this depression when the general area was receiving carbonaceous mud in the latest Devonian or earliest Mississippian time. With the loading of the region by later sediments, the mud was compacted by the squeezing out of its fluids. The fissility was produced by the orientation of mineral flakes during this process of dehydration. The fissibility is observed to be parallel to the bedding except where it conforms to ancient hillslopes. Here true bedding was not found, but since the fissility is inclined as much as 30°, it is to be doubted if the newly deposited layers stood at that high angle. The average altitude of the top of the shale is generally less in this area because in so thick a body of shale the total amount of compacting was proportionately greater, although part of the difference in elevation may be accounted for by the gentle folding of the region.

It is doubtful if this is the only feature of the sort; others exist but have remained unnoted. The existence of a sinkhole with a depth of nearly two hundred feet indicates that in pre-Chattanooga time the altitude of this part of the continent was probably at least two hundred feet above sea-level long enough for sinkholes to be formed of the general size of many of the present depressions in the area of the Standingstone quadrangle, Tennessee.

RALPH G. LUSK

HARVARD UNIVERSITY

[4] Bucher, Walter H., "Crypto-volcanic Structure in Ohio of the Type of the Steinheim Basin" (abstract): Geol. Soc. Amer. Bull., Vol. 32, no. 1, pp. 74–75. 1921.